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ABSTRACT

This curriculum guide is designed for group instruction of secondary agricultural education students enrolled in one or two semester-long courses in agriculture structures. The guide presents units of study in the following areas: (1) shop safety, (2) identification and general use of hand tools, (3) power tools, (4) carpentry, (5) blueprint reading for structures, (6) plumbing, (7) electricity, (8) concrete and masonry for structures, and (9) surveying for structures. Each of the nine units of instruction follows a typical format: terminal objective, specific objectives, suggested instructor and student activities, instructional materials, information sheet, transparency masters, assignment sheets, and a student test. (LRA)

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AGRICULTURE EDUCATION

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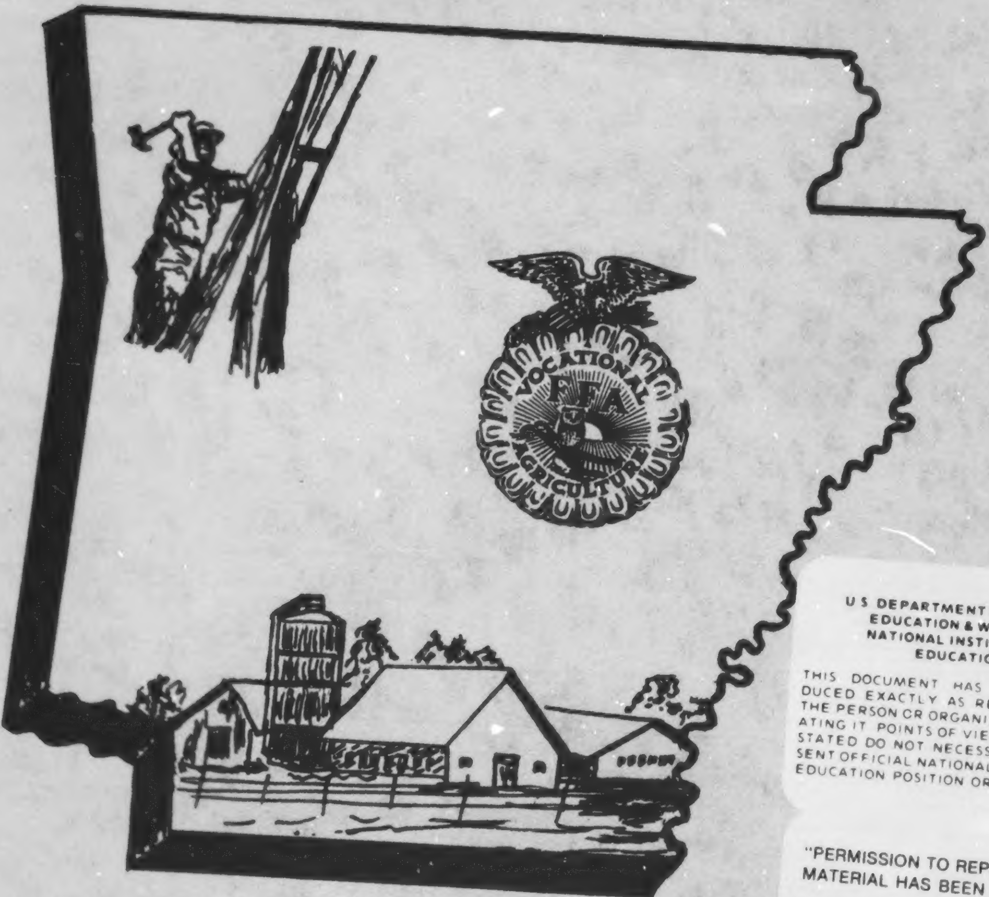

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AGRICULTURE STRUCTURES

PREFACE

This curriculum guide is a suggested method of group instruction for students enrolled in one or two semester-long courses in Agriculture Education.

This material is intended to cover those items which a student will most likely encounter when employed in this given area of agriculture.

Individualized instructional material should be supplemented to this curriculum guide to meet individual and local needs.

This curriculum guide contained herein was performed pursuant to a contract with the Exemplary Section, Division of Vocational, Technical and Adult Education, Arkansas Department of Education.

ACKNOWLEDGEMENT

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The content of this publication was prepared and reviewed by:

AGRICULTURE EDUCATION STAFF
STUTTGART PUBLIC SCHOOLS

Ned Moseley	Superintendent
J.E. Lawrence	Principal
Joe C. Williams	Principal
John Gentry	Soybean and Rice Production
Glenn Aubrey	Soybean and Rice Production
Vincent Lum	Soybean and Rice Production
Anthony Ashlock	Farm Machinery
Roger Clark	Horticulture
James Rodgers	Horticulture
James Branson	Elements of Farm and Building Layout
Greg Goss	Agriculture Structures
Harlan Peacock	Agriculture Structures
John C. Davis	Agriculture Structures
Richard Gray	Agricultural Metal Working
Wayne Smith	Agricultural Metal Working
James Phillips	Agricultural Metal Working

INSTRUCTORS OF VOCATIONAL AGRICULTURE

Dick Pirkey
Danny Blalock
Billy Watkins
James Gambill
Johnny Neel
Martin Gosset
Dale Thompson
Tom Walker
Lee Griffith
Jack Warnock
Ralph A. Cheshier
Ron Highfill
Wallace Wortham
Jackie Brown
Jack McCord
David Nordin
Garlen T. Willis
Thomas G. Baker
Jim Penn
Troy W. Buck
James Morris
Jimmy Stotts
Thomas Craig
Melvin Daniel
Tommie L. Brown
Jesse F. Bush
Reuben McClelland
Gary Hines
Glen Tice
Terry Waits
David Montgomery
J.R. Buckner

Jerry S. Speir
Howard Easterling
Phillip Rows
James Neely
Harold Ramsey
Emmit Biswell
David Holcombe
Bruce Rylant
William O. McCoy
Tilman Adams
Clyde West
Charles Harvill
Terry Williams
Glynn Gibson
Eddie Plunkett
John Rankin
David Marcantel
James Nicholson
Jerry Davis
Bob Misenheimer
Gary McGhee
Richard L. Penn
Sam Mullins
Marion Spaulding
Patrick Sullivan
Lanny Rice
James Floyd
Ben Lawrence
Danny Allen
William Stark
John Turner
Mickey Sweeney
Jack Watkins
Herman Scott
Gail Thrower
James Boyd
Floyd Gray
Malcolm Patterson
Skip Emmett
Tommie Hill

STATE DEPARTMENT OF EDUCATION VOCATIONAL STAFF

James Dasher
Robert Crawley
Unice Latimer
Bob Verboon
Travis Hopper
Don Harlan
Marion Fletcher
Linda Beene
Peggy Patrick

Other contributors were;

Ciba Geigy Corporation, Greensboro, North Carolina

Alabama State Department of Education, Auburn, Alabama

New Mexico State Department of Education, Santa Fe, New Mexico

State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, Stillwater, Oklahoma

John Deere and Company, Moline, Illinois

American Association for Vocational Instructional Materials, Room 120, Engineering Center, Athens, Georgia

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SECTION A

UNIT I

SHOP SAFETY

SHOP SAFETY

TERMINAL OBJECTIVE

After completion of this unit, the student will be able to state rules for shop and personal safety. The student will recognize unsafe situations and select the correct fire extinguisher for the classes of fire.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

I. Define terms relating to shop safety.

II. List the two most frequent causes of accidents on farms.

III. List six precautions that may be taken to prevent accidents in a shop.

IV. List six steps in shop housekeeping.

V. List seven safety rules to remember when working with machinery.

VI. Match the six colors of the safety color code with statements of thier use.

VII. Match the three classes of fire with statements defining each class.

VIII. Select from a list of fire extinguishers the types best suited to extinguish each class of fire.

SHOP SAFETY

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information sheet.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheets.

  F. Give test.

II. Student:

  A. Read Objective sheet.

  B. Study information sheets.

  C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency master

    1. TM 1 - Types of Fire Extinguishers

  D. Assignment sheets

    1. Assignment sheet #1 - Farm Accidents

    2. Assignment sheet #2 - Horseplay

    3. Assignment sheet #3 - Fire

    4. Assignment sheet #4 - Fire Extinguishers

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. Phipps, Lloyd, Farm Mechanics Text and Handbook, Danville, Illinois, The Interstate Printers and Publishers, Inc., 1964.

B. Feirer, John L., I.A. Bench Woodwork, Peoria Illinois, Charles A. Bennet Co., Inc. 1965.

C. Willoughly, George A., General Shop Handbook, Peoria, Illinois, Charles A. Bennet Co., Inc. 1955.

D. Oklahoma Safety Unit, Stillwater Oklahoma, State Department of Vocational and Technical Education, 1973.

SHOP SAFETY

INFORMATION SHEET

I. Terms:

   A. SAFETY - State or condition of being safe; freedom from danger, risk or injury.

   B. ACCIDENT - Any unintentional event which causes injury or property damage.

   C. FIRST AID - Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained.

II. The two most frequent causes of accidents on farms:

   A. Animals

   B. Farm Machinery

III. Six precautions that may be taken to prevent accidents in a farm shop:

   A. Always dress correctly for the job.

      1. Roll up sleeves and tuck in tie or scarf or remove it.

      2. Never wear loose fitting clothes.

      3. Wear a protective apron.

      4. Always wear eye shields or goggles when grinding, sanding or drilling.

      5. Follow instructions given by the instructor.

      6. The A,B,C's of safety are Always Be Careful.

IV. The six steps used in shop housekeeping are:

   A. Keep the top of your bench and the floor around it clean and neat.

   B. Put your tools away after you have used them.

   C. When carrying tools. always keep the pointed ends down and away from you.

INFORMATION SHEET

D. Wipe up oil and grease spots.

E. Keep rags in a metal container.

F. Place scrap stock in scrap boxes immediately.

V. Safety rules to remember when working with machinery.

A. Machine guards in proper position.

B. Proper precautions should be taken when lighting gas furnaces to avoid burns and explosions.

C. Paint and finishing cabinets should be kept clean and free from paint and saturated rags as serious fires may result from poorly kept cabinets.

D. Goggles should be worn when working at grinder and while chipping or pouring metals even though the operation may take only a moment. Flying chips from cutting tools and sparks from grinders can cause serious injury to the eyes.

E. Hammers should be inspected regularly for loose or broken handles and repair made promptly as a flying hammer head is a dangerous missile.

F. A mushroomed tool generally has a very ragged edge which is caused by hammer blows. The top of a cold chisel is an example. Serious injury may be the result as loose chips fly when the tool is struck by a hammer. The ragged edges must be removed.

G. In no case must the grinder tool rest exceed one-eighth inch distance from the stone as a serious accident may result from wedging stock between the tool rest and the stone.

VI. Colors and application of the safety color code.

A. Federal Safety Red - The basic color for the identification of:

1. Fire protection equipment and apparatus.

2. Portable containers of flammable liquids.

3. Emergency stop bars, stop buttons and emergency electrical stop switches on machinery.

INFORMATION SHEET

B. Federal Safety Yellow - The basic color for designating:

   1. Caution and for marking physical hazards.

   2. Waste containers for explosive or combustible materials.

   3. Caution against starting, using or moving equipment under repair.

   4. Identification of the starting point or power source of machinery.

C. Federal Safety Orange - The basic color for designating:

   1. Dangerous parts of machines.

   2. Safety starter buttons.

   3. The exposed parts (edges only) of pulleys, gears, rollers, cutting devices and power jaws.

D. Federal Safety Purple - The basic color for designating: Radiation Hazards

E. Federal Safety Green - The basic color for designating:

   1. Safety

   2. Location of first aid equipment.

F. Federal Safety Black and White (Used individually or in combination) - The basic color for designating:

   1. Traffic flow

   2. Housekeeping purposes.

VII. Three classes of fires:

   A. Class A - Fires that occur in ordinary combustible materials such as wood, rags and rubbish.

   B. Class B - Fires that occur with flammable liquids such as gasoline, oil, grease, paints and thinners.

INFORMATION SHEET

C. Class C - Fires that occur in or near electrical equipment such as motors, switch boards and electrical wiring.

VIII. Types of fire extinguishers:

A. Pressurized Water - Operates usually by squeezing a handle or trigger; used on class A fires.

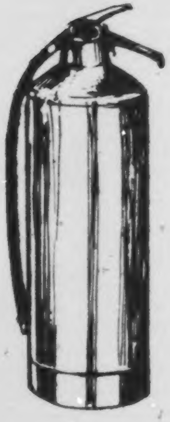
B. Soda Acid - Operates by turning extinguisher upside down; used on class A fires.

C. Carbon Dioxide (CO_2) - Operates usually by squeezing handle or trigger; used on class B and C fires.

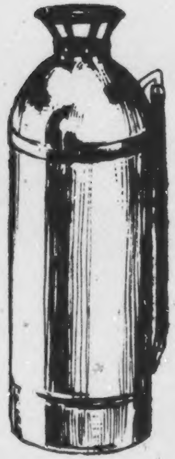
D. Dry Chemical - Operates usually by a handle trigger or lever; used on class B and C fires.

E. Foam - Operates by turning extinguisher upside down; used on class A and B fires.

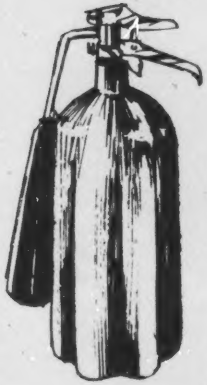
Types of Fire Extinguishers



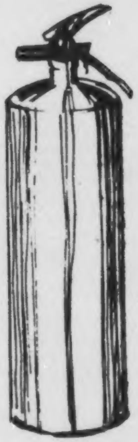
Pressurized Water



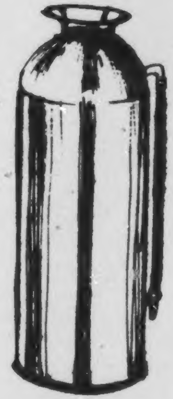
Soda-Acid



Carbon Dioxide



Dry Chemical



Foam

SHOP SAFETY

ASSIGNMENT SHEET #1 - FARM ACCIDENTS

Prepare a one page report on farm accidents in your area.

SHOP SAFETY

ASSIGNMENT SHEET #2 - HORSEPLAY

Prepare a one page report on the danger of horseplay in a shop. Using the newspaper, find a true story to make your point.

SHOP SAFETY

ASSIGNMENT SHEET #3 - FIRE

Prepare a report on fire hazards that are found in every shop.

(Include types of fires)

SHOP SAFETY

ASSIGNMENT SHEET #4 - FIRE EXTINGUISHERS (TM 1)

Prepare a one page report on each of the following.

A. Pressurized Water

B. Soda Acid

C. Carbon Dioxide

D. Dry Chemical

E. Foam

SHOP SAFETY

ANSWERS TO ASSIGNMENT SHEETS

Assignment sheet #1

To the satisfaction of the instructor.

Assignment sheet #2

To the satisfaction of the instructor.

Assignment sheet #3

To the satisfaction of the instructor.

Assignment sheet #4

To the satisfaction of the instructor.

SHOP SAFETY

TEST

I. Define the following terms related to shop safety.

A. Safety-

B. Accident-

C. First Aid-

II. List the two most frequent causes of accidents on farms.

A.

B.

III. List the six precautions that may be taken to prevent accidents in a shop.

A.

B.

C.

D.

E.

F.

IV. List six steps in shop housekeeping.

A.

B.

C.

D.

E.

F.

V. List seven safety rules to remember when working with machinery.

A.

B.

C.

D.

E.

F.

G.

VI. Match the following colors of the safety color code with the correct statements of thier use.

___A. Used to identify fire protection equipment and apparatus.

___B. Designates the location of safety and first aid equipment.

___C. Designates dangerous parts of equipment which may cut, crush, shock or otherwise cause injury.

___D. Designates caution against starting, using or moving equipment under repair.

___E. Designates traffic flow.

___F. Designates radiation hazards.

1. Green
2. Black & White
3. Orange
4. Purple
5. Red
6. Yellow

VII. Match the three classes of fire with the correct statement defining each class.

___A. Fires that occur with flammable liquids such as gasoline, oil, grease, paints and thinners.

___B. Fires that occur in ordinary combustible materials such as wood, rags and rubbish.

___C. Fires that occur in or near electrical equipment such as motors, switch boards and electrical wiring.

1. Class A
2. Class B
3. Class C

VIII. Write the number or numbers of the fire extinguisher best suited to extinguish each class of fire.

_______A. Fires that occur with flammable liquids such as gasoline, oil, grease, paint and thinner.

_______B. Fires that occur in or near electrical equipment such as motors, switch boards and electrical wiring.

_______C. Fires that occur in ordinary combustible materials such as wood, rags and rubbish.

1. Pressurized Water
2. Carbon Dioxide
3. Dry Chemical
4. Soda Acid
5. Foam

IX. Hand in assignment sheets 1,2,3 and 4.

SHOP SAFETY

ANSWERS TO TEST

I. A. Safety - State or condition of being safe; freedom from danger, risk or injury.

B. Accident - Any unintentional event which causes injury or property damage.

C. First Aid - Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained.

II. A. Animals

B. Farm Machinery

III. A. Roll up sleeves and tuck in tie or scarf or remove it.

B. Never wear loose fitting clothes.

C. Wear a protective apron.

D. Always wear eye shields or goggles when grinding, sanding or drilling.

E. Follow instructions given by the instructor.

F. The A,B,C's of safety are Always Be Careful.

IV. A. Keep the top of your bench and the floor around it clean and neat.

B. Put your tools away after you have used them.

C. When carrying tools, always keep the pointed ends down and away from you.

D. Wipe up oil and grease spots.

E. Keep rags in a metal container.

F. Place scrap stock in scrap boxes immediately.

V. A. Machine guards in proper position.

B. Proper precautions should be taken when lighting gas furnaces to avoid burns and explosions.

C. Paint and finishing cabinets should be kept clean and free from paint and saturated rags as a serious fire may result from poorly kept cabinets.

D. Goggles should be worn when working at grinder and while chipping or pouring metals even though the operation may take only a moment. Flying chips from cutting tools and sparks from grinders can cause serious injury to the eyes.

E. Hammers should be inspected regularly for loose or broken handles and repair made promptly as a flying hammer head is a dangerous missile.

F. A mushroomed tool generally has a very ragged edge which is caused by hammer blows. The top of a cold chisel is an example. Serious injury may be the result as loose chips fly when the tool is struck by a hammer. The ragged edges should be removed.

G. In no case must the grinder tool rest exceed one-eighth inch distance from the stone as a serious accident may result from wedging stock between the tool and the stone.

VI. A. 6

B. 1

C. 3

D. 7

E. 2

F. 4

VII. A. 2

B. 1

C. 3

VIII. A. 2,3 and 5

B. 2 and 3

C. 1,4 and 5

IX. To be evaluated by the instructor.

SECTION B

UNIT I

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

TERMINAL OBJECTIVE

After completion of this unit, the student should able to identify hand tools common to the carpentry trade and know the general use of each.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Identify five types of hand saws and write a use for each.

II. Identify four types of hammers and write a use for each.

III. Identify three types of planes and write a use for each.

IV. Identify four types of squares and give a use for each.

V. Identify three types of ladders.

VI. Identify four types of wrenches.

VII. Identify three types of levels.

VIII. Identify four types of rasps by shape.

IX. Identify three types of boring tools.

X. Identify three types of measuring tools.

XI. Identify three types of clamps.

XII. Identify two types of screwdrivers.

XIII. Identify thirteen miscellaneous tools.

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheets.

   F. Provide display of tools.

   G. Demonstrate the use of each tool.

   H. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Practice using each tool after receiving instructions from the instructor on the correct use of the tool.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Types of Hand Saws

      2. TM 2 - Types of Hammers

      3. TM 3 - Types of Planes

4. TM 4 - Types of Squares
5. TM 5 - Types of Ladders
6. TM 6 - Types of Levels and Wrenches
7. TM 7 - Types of Rasps
8. TM 8 - Types of Boring Tools
9. TM 9 - Types of Clamps
10. TM 10 - Types of Screwdrivers
11. TM 11 - Types of Miscellaneous Tools

D. Test

E. Answers to test

II. References:

A. Wagner, Willis H., Modern Carpentry, Homewood, Illinois, Goodheart Wilcox Co, Inc., 1969.

B. Groneman, Chris H., The Industries, Austin, Texas, The Stack Co., 1944.

C. Residential Carpentry, Stillwater, Oklahoma, State Department of Vocational and Technical Education, 1973.

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

I. Identification of hand saws and thier uses.

- A. Cross-cut
  - 1. Identification:
    - a. 18" to 26" long.
    - b. 4 to 12 points per inch.
    - c. Teeth filed at an angle across thier face.
  - 2. Use:
    - a. Cuts across the grain.
- B. Rip Saw
  - 1. Identification:
    - a. 20 to 28 inches long.
    - b. 5 to 7 points per inch.
    - c. Teeth filed square across.
  - 2. Use:
    - a. Cuts with the grain of wood.
- C. Coping Saw
  - 1. Identification:
    - a. Has a "U" shaped frame.
  - 2. Use:
    - a. Cuts curves.
- D. Compass Saw (keyhole saw)
  - 1. Identification:
    - a. 12 to 14 inches in length.
    - b. Tapered blade.
    - c. Sometimes a pistol grip handle.

INFORMATION SHEET

   2. Use:
      a. Cuts gentle curves.
      b. Cuts inside corners.

- E. Back saw (Miter box saw)
   1. Identification:
      a. 12 to 28 inches in length.
      b. Blade thinner than other mentioned saws.
      c. 11 points per inch.
   2. Use:
      a. Normally used in molding work.

II. Identification of hammers and their uses.

- A. Claw hammer
   1. Identification:
      a. Curved claw.
      b. Head with range of 13 to 20 ounces.
   2. Use:
      a. Driving or pulling nails.
- B. Claw hammer (Straight claw or ripping hammer)
   1. Identification:
      a. Near straight claw.
      b. Head with range of 16 to 20 ounces.
   2. Use:
      a. Ripping or wrecking.
- C. Sledge hammer
   1. Identification:
      a. Hammer head normally has two identical faces.

INFORMATION SHEET

- b. Head weighs from 2 to 20 pounds.
- 2. Use:
  - a. Driving stakes.
  - b. Wrecking.

D. Half Hatchet

1. Identification:
   - a. One end of head has sharp edge.
   - b. Hammer face on one side of head.
   - c. "V" shaped slot on blade side.
2. Use:
   - a. Shingling.
   - b. Sharpening stakes when on the job site.

III. Identification of planes and their uses:

A. Smooth plane

1. Identification:
   - a. 1 5/8" to 2 3/8" width of cut.
   - b. 7" to 10" long.
2. Use:
   - a. Smoothing short, straight surfaces and long irregularly shaped surfaces.

B. Jack plane

1. Identification:
   - a. 11½" to 15" long.
   - b. 1 3/4" to 2 3/8" width of cut.
2. Use:
   - a. General purpose.

INFORMATION SHEET

C. Jointer plane

1. Identification:

   a. 22" to 24" long.

   b. 2 3/8" to 2 5/8" width of cut.

2. Use:

   a. Straightening and smoothing the edges of long stock.

IV. Identification of squares and their uses: TM 4

A. Framing square (Csrpenters square)

1. Identification:

   a. Twenty-four inch blade measuring two inches in width.

   b. Sixteen inch tongue measuring one and one-half inches in width.

   c. Rafter and brace tables stamped on blade.

2. Use:

   a. Square boards.

   b. Measure rafters.

   c. Measure braces.

   d. Make a square corner.

   e. Measure stairway.

B. Combination square

1. Identification:

   a. Twelve inch blade.

   b. Adjustable handle that normally contains a level and a scribe.

2. Use:

   a. Squaring.

INFORMATION SHEET

- b. Leveling.
- c. 45° miter.

C. Bevel-Protractor head

- 1. Identification:
  - a. 12" blade.
  - b. Beveling protractor head that slides up or down the blade.
- 2. Use:
  - a. Measure miter angles.
  - b. Proper angle when sharpening tools.

D. Sliding T bevel

- 1. Identification:
  - a. Adjustable blade.
  - b. Blade that normally has a 45° bevel on the end.
- 2. Use:
  - a. Transfer angles from 0° to 180°.

V. Types of ladders.TM 5

- A. Extension
- B. Step
- C. Single

VI. Types of wrenches. TM 6

- A. Open end
- B. Box end
- C. Combination
- D. Adjustable

INFORMATION SHEET

VII. Types of levels. TM 6
  A. String or line
  B. Carpenters
  C. Torpedo

VIII. Types of rasps. TM 7
  A. Flat
  B. Half round
  C. Round
  D. Triangular

IX. Types of boring tools. TM 8
  A. Carpenters brace
  B. Auger bit
  C. Flat bit (speed bit)

X. Types of measuring tools. TM 5
  A. Bench rule
  B. 6' folding rule
  C. Steel tape

XI. Types of clamps. TM 9
  A. Bar
  B. "C"
  C. Hand screw

XII. Types of screwdrivers. TM 10
  A. Standard (common)
  B. Phillips

INFORMATION SHEET

XIII. Miscellaneous tools. TM 11a & 11b

A. Outside calipers or dividers

B. Chalk line

C. Wood chisels

D. Tin snips

E. Nail set

F. Bolt cutter

G. Nail puller

H. Square point shovel

I. Round point shovel

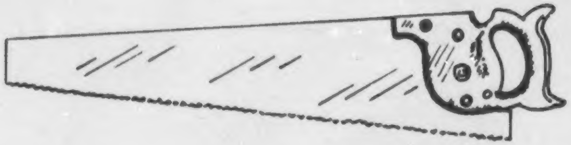
J. Scoop

K. Push broom

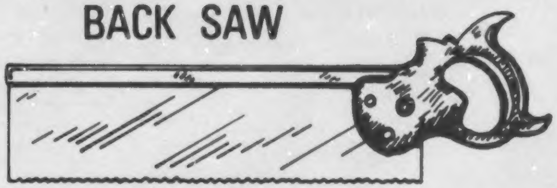
L. Hand broom

M. Bench brush

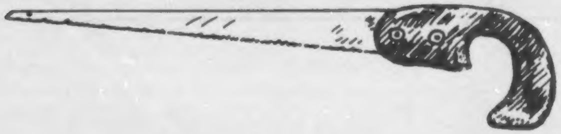
Types of Handsaws

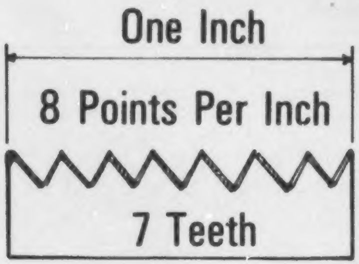


BACK SAW

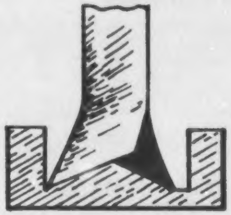


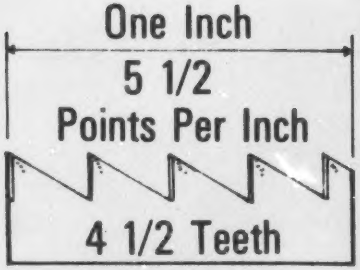
COMPASS SAW



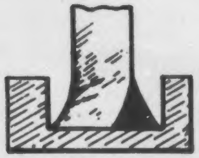

One Inch
8 Points Per Inch
7 Teeth

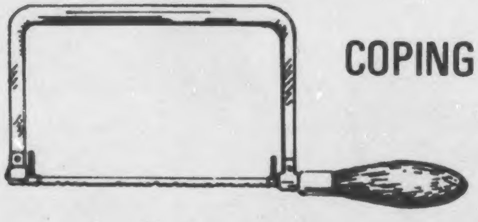
CROSSCUT SAW




One Inch
5 1/2
Points Per Inch
4 1/2 Teeth

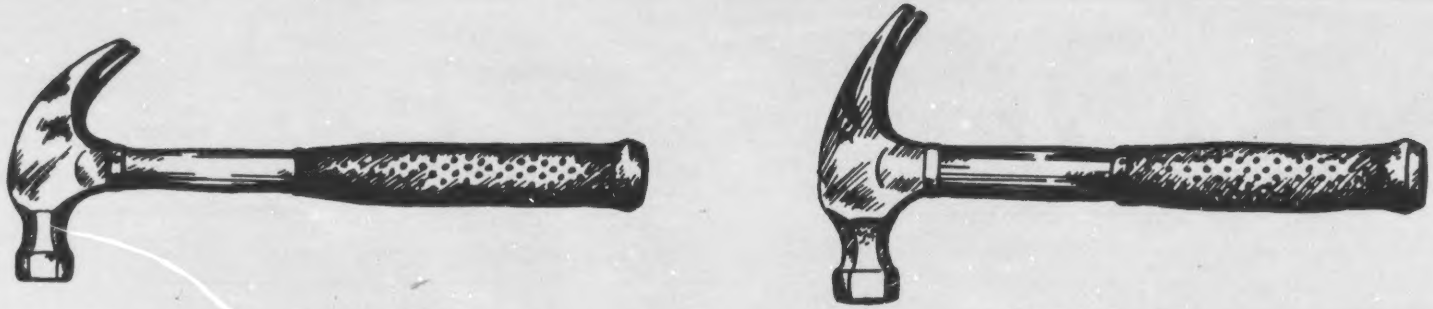
RIP SAW





COPING SAW

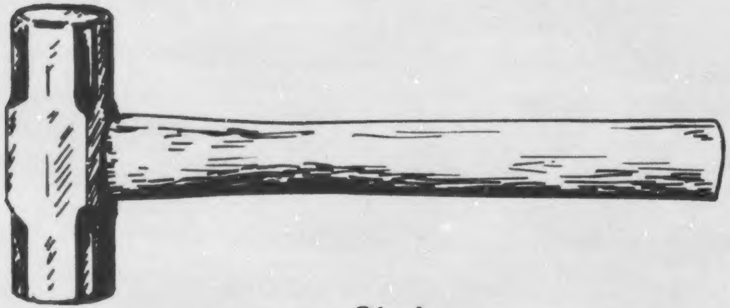
Types of Hammers



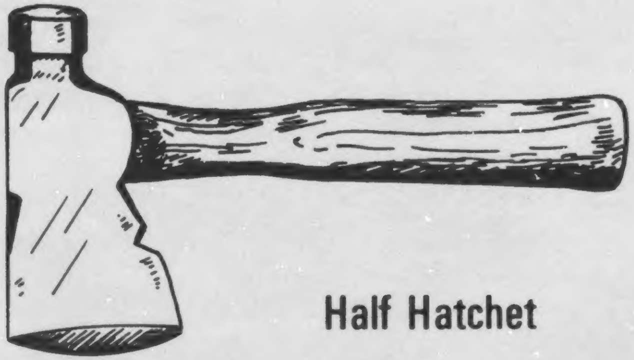
Curved Claw

Straight Claw

CLAW HAMMERS

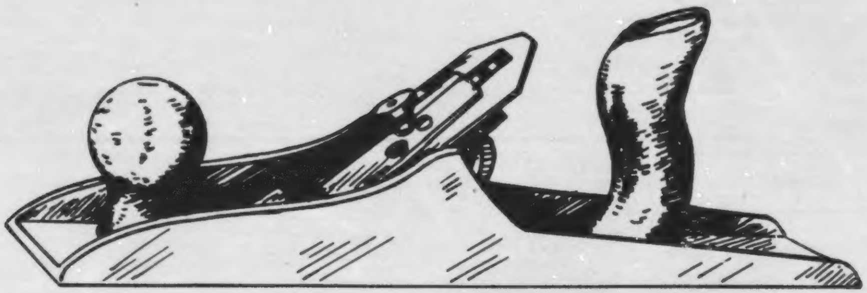


Sledge



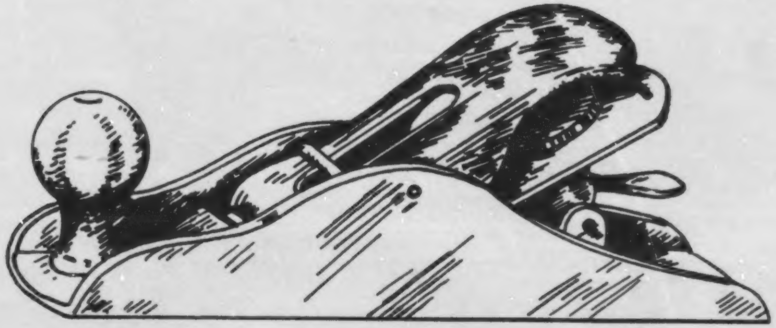
Half Hatchet

Types of Planes

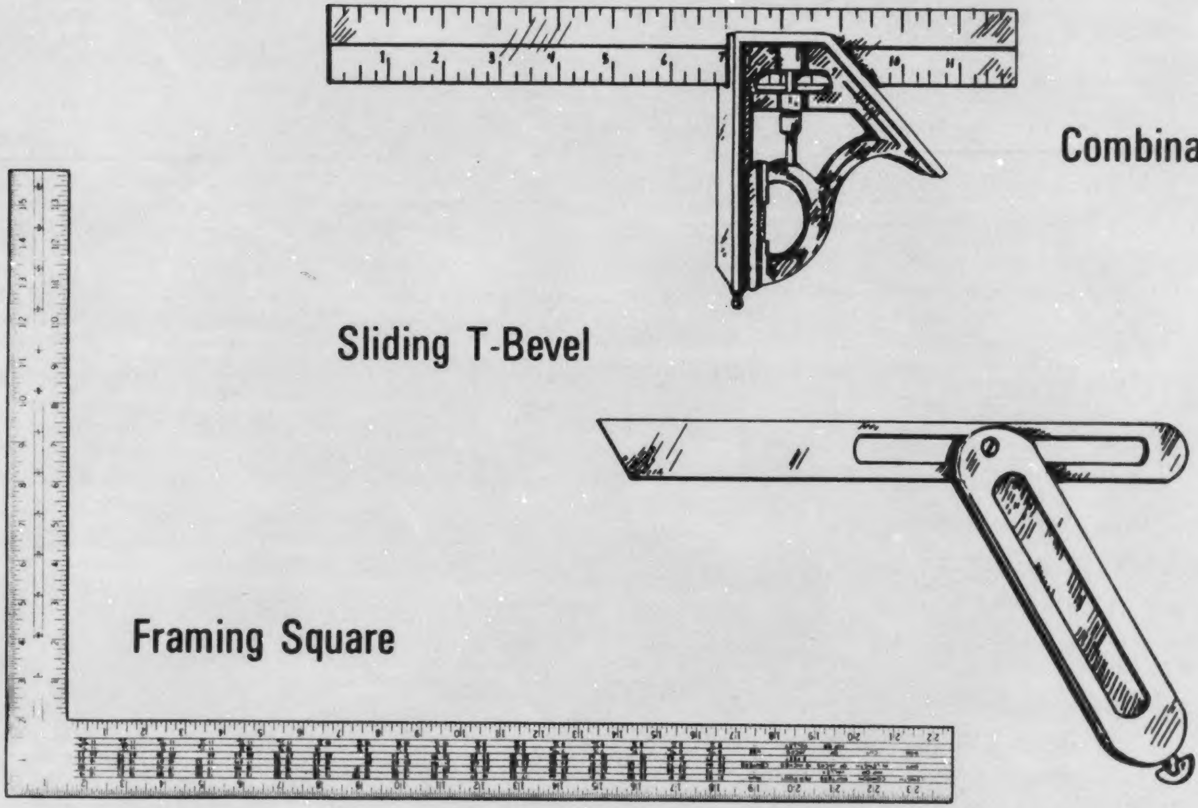


Jack Plane

Block Plane



Types of Squares



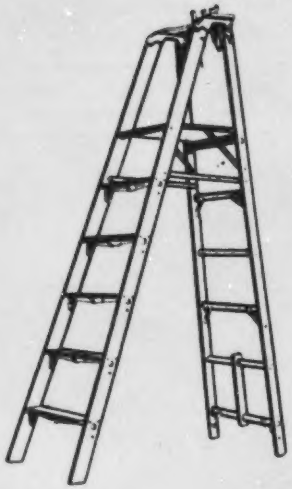
Combination Square

Sliding T-Bevel

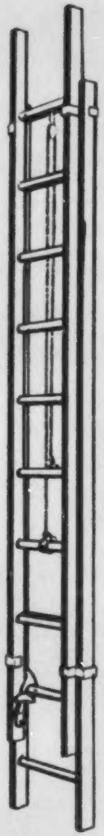
Framing Square

Types of Ladders and Measuring Instruments

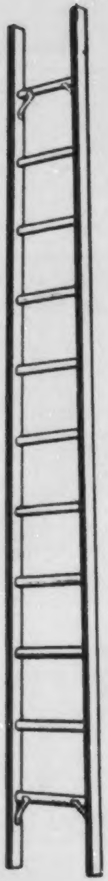
LADDERS



Step-Ladder

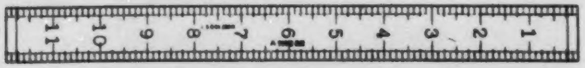


Extension Ladder

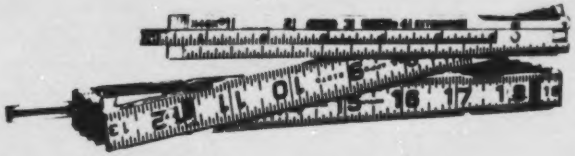


Single Ladder

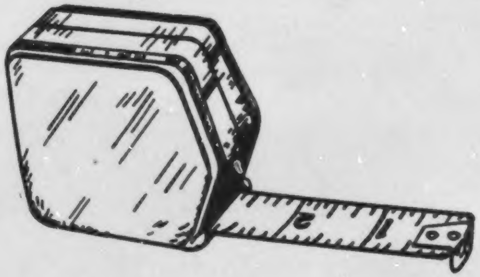
MEASURING INSTRUMENTS



Bench Rule



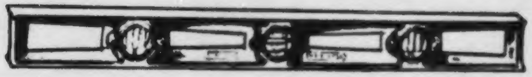
Folding Rule



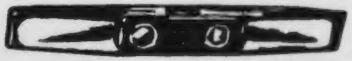
Steel Tape

Types of Levels and Wrenches

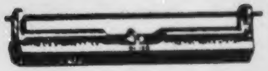
LEVELS



Carpenter's

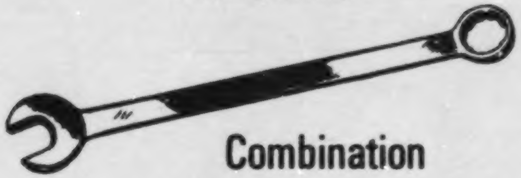


Torpedo

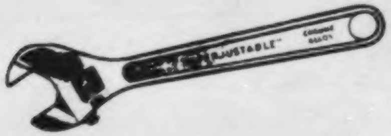


Line

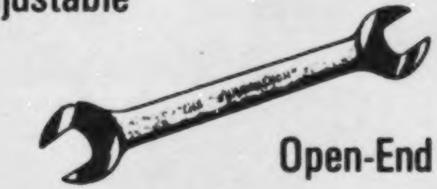
WRENCHES



Combination

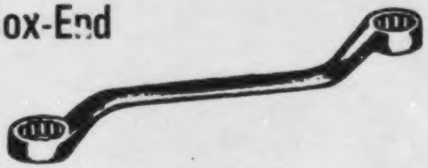


Adjustable



Open-End

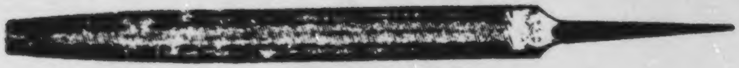
Box-End



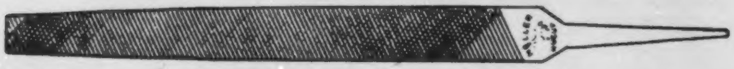
AS - 25-B

Types of Rasps

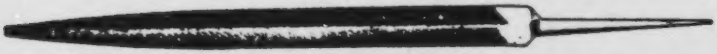
FILES



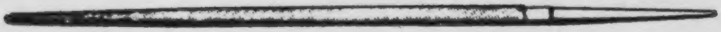
Half-Round Wood



Flat Wood



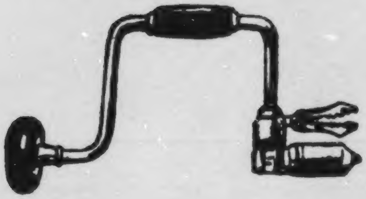
Triangular Wood



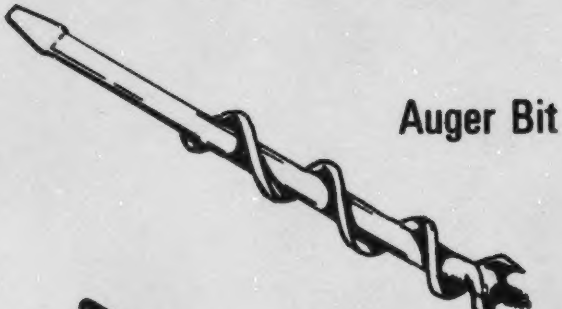
Round Wood

AS - 27-B

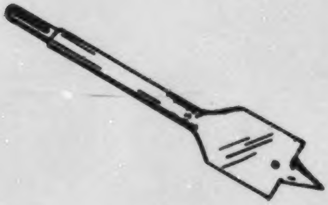
Types of Boring Tools



Carpenter Brace

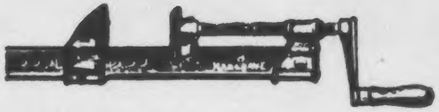


Auger Bit

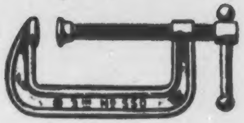


Flat Bit
(Speed Bit)

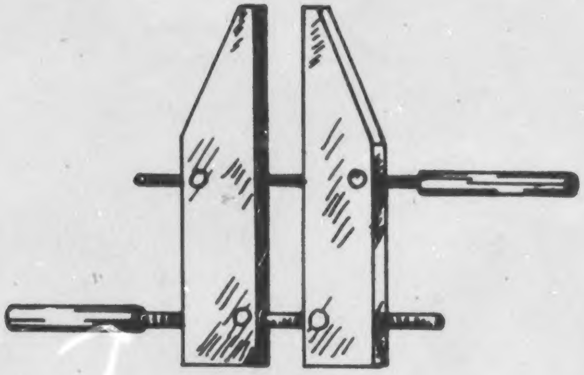
Types of Clamps



Bar



"C"

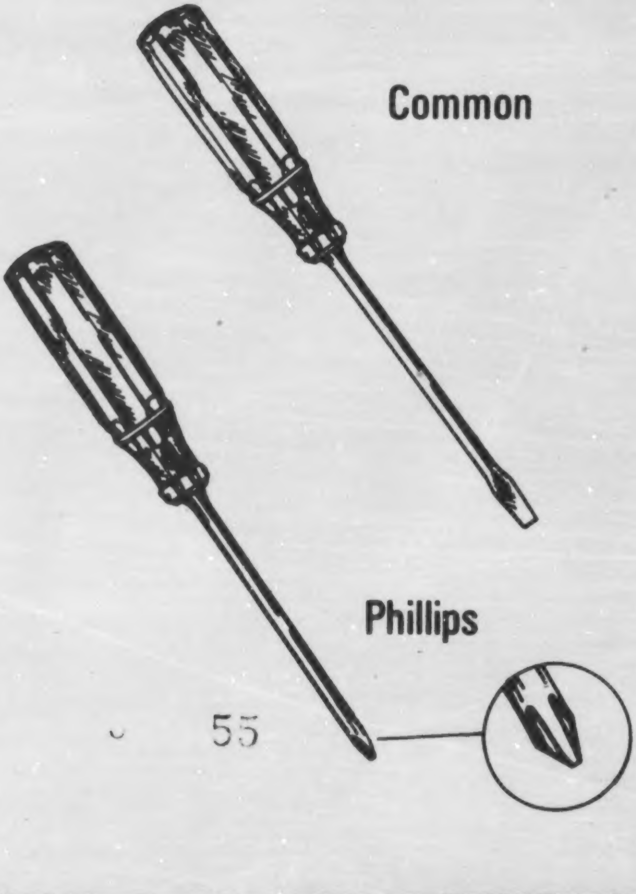


Hand Screw

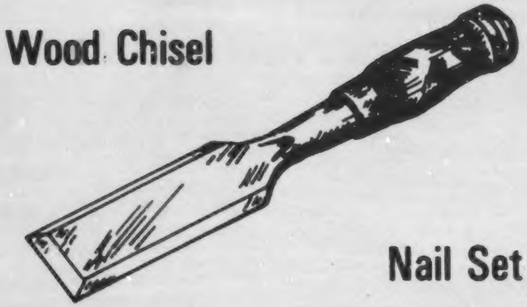
AS - 31-B

Types of Screwdrivers

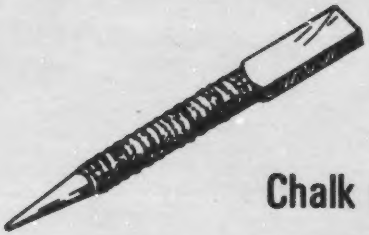
SCREWDRIVERS


Common
Phillips

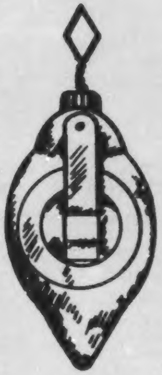
Types of Miscellaneous Tools



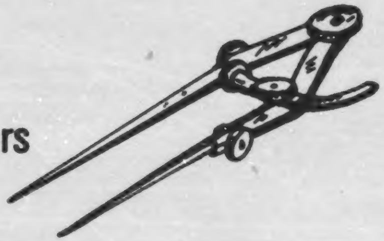
Wood Chisel



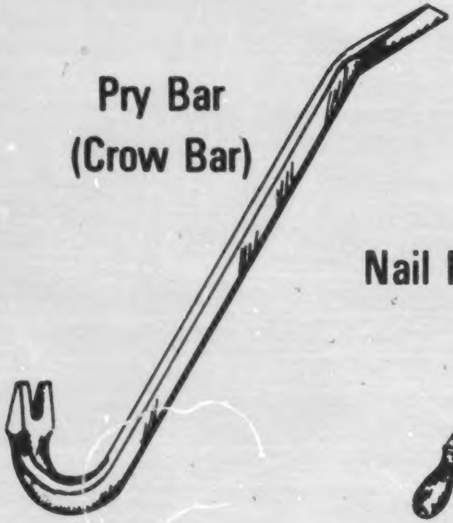
Nail Set



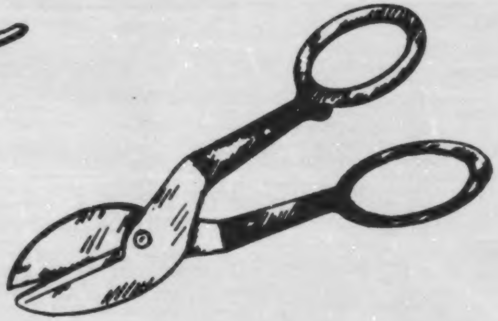
Chalk Line and Reel



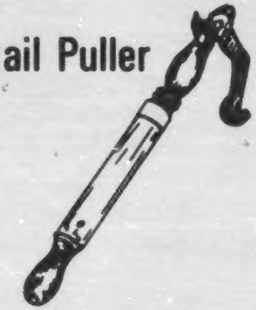
Dividers



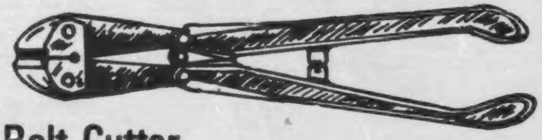
Pry Bar (Crow Bar)



Tin Snips



Nail Puller



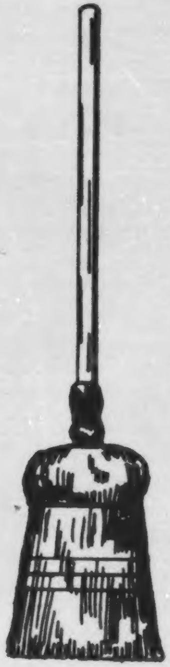
Bolt Cutter

AS - 35-B

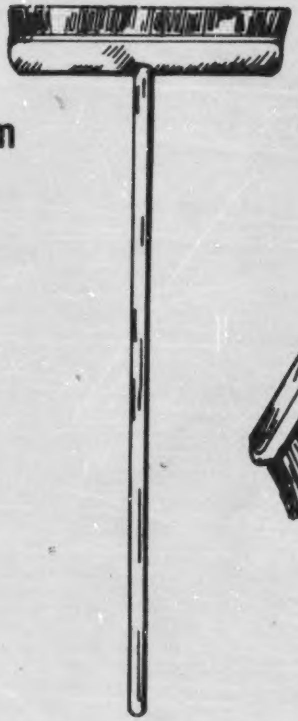
TM 11b

Types of Miscellaneous Tools

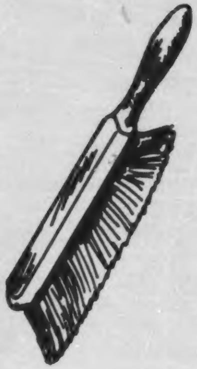
Hand Broom



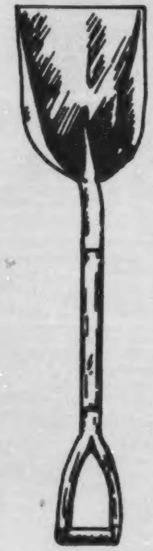
Push Broom



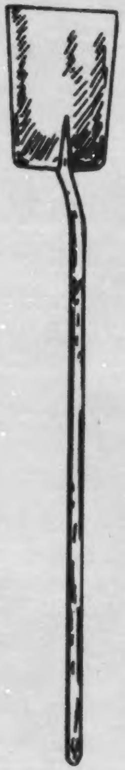
Bench Brush

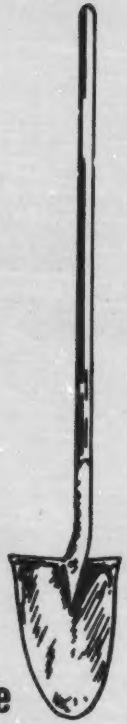


Sand Scoop



Long Handle
Square Point Shovel





Long Handle
Round Point Shovel

AS - 37-B

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

TEST

I. Identify five types of hand saws and write a use for each.

A. Identification:	B. Use:
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

II. Identify four types of hammers and write a use for each.

A. Identification:	B. Use:
1.	1.
2.	2.
3.	3.
4.	4.

III. Identify three types of planes and write a use for each.

A. Identification:	B. Use:
1.	1.
2.	2.
3.	3.

IV. Identify four types of squares and give a use for each.

A. Identification:	B. Use:
1.	1.
2.	2.
3.	3.
4.	4.

V. Identify three types of ladders.

A. B. C.

VI. Identify four types of wrenches.

A.

B.

C.

D.

VII. Identify three types of levels.

A. B. C.

VIII. Identify four types of rasps by shape.

A.

B.

C.

D.

IX. Identify three types of boring tools.

A. B. C.

X. Identify three types of measuring tools.

A. B. C.

XI. Identify three types of clamps.

A. B. C.

XII. Identify two types of screwdrivers.

A. B.

XIII. Identify thirteen miscellaneous tools.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

M.

IDENTIFICATION AND GENERAL USE OF HAND TOOLS

ANSWERS TO TEST

I. Hand saws

A. Identification:	B. Use:
1. Cross Cut	1. Cuts across the grain.
2. Rip saw	2. Cuts with the grain of wood.
3. Coping saw	3. Cuts curves.
4. Compass saw	4. Cuts gentle curves or cuts inside corners.
5. Back saw	5. Normally used in molding work.

II. Hammers

A. Identification:	B. Use:
1. Claw hammer	1. Driving or pulling nails.
2. Claw hammer (Straight claw or ripping)	2. Ripping or wrecking.
3. Sledge hammer	3. Driving stakes or wrecking.
4. Half hatchet	4. Shingling or sharpening stakes when on the job site.

III. Planes

A. Identification:	B. Use:
1. Smooth plane	1. Smoothing short, straight surfaces and long irregular shaped surfaces.
2. Jack plane	2. General purpose.
3. Jointer plane	3. Straightening and smoothing the edges of long stock.

IV. Squares

A. Identification:	B. Use:
1. Framing square	1. Square boards, measure rafters, measure braces. make a square corner or measure stairway.
2. Combination square	2. Squaring, leveling or 45° miter.
3. Bevel-protractor head	3. Measure miter angles or proper angle when sharpening tools.
4. Sliding T bevel	4. Transfer angles from 0° to 180°.

V. A. Extension
    B. Step
    C. Single

VI. A. Open end
    B. Box end
    C. Combination
    D. Adjustable

VII. A. String or line
    B. Carpenters
    C. Torpedo

VIII. A. Flat
    B. Half round
    C. Round
    D. Triangular

IX. A. Carpenters brace
    B. Auger bit
    C. Flat bit

X. A. Bench rule
   B. 6' folding rule
   C. Steel tape

XI. A. Bar
   B. "C"
   C. Hand screw

XII. A. Standard (common)
   B. Phillips

XIII. A. Outside calipers or dividers
   B. Chalk line
   C. Wood chisels
   D. Tin snips
   E. Nail set
   F. Bolt cutter
   G. Nail puller
   H. Square point shovel
   I. Round point shovel
   J. Scoop
   K. Push broom
   L. Hand broom
   M. Bench brush

SECTION C

UNIT I

POWER TOOLS

POWER TOOLS

TERMINAL OBJECTIVE

The student, upon completion of this unit, should be able to distinguish the difference between stationary and portable power tools, understand the basic operation and identify the basic parts of all the power tools listed. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match thirteen terms to the correct definition or function.

II. Distinguish the difference between seven types of stationary power tools and six types of hand operated or portable power tools.

III. Match a list of basic operations or jobs to thirteen respective power tools.

IV. Match a list of basic parts to the illustration of thirteen power tools.

V. Demonstrate the ability to:

  a. Crosscut with the table saw or bench saw.

  b. Ripping with the table saw or bench saw.

  c. Crosscut with the radial arm saw.

  d. Crosscut with a electric hand saw.

POWER TOOLS

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective and information sheets.

   B. Discuss the different machine operations on jobs.

   C. Discuss the fundamentals of operations and identify each part of the power tools.

   D. Make transparencies.

   E. Discuss the procedures on the job sheets.

   F. Give test.

II. Students:

   A. Study the information sheets provided by the instructor.

   B. Demonstrate the ability to perform the jobs listed on the job sheets.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Materials included in this unit:

   A. Objectives

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Table Saw or Bench Saw

      2. TM 2 - Radial Arm Saw

      3. TM 3 - Band Saw

      4. TM 4 - Jointer

      5. TM 5 - Planer Surfacer

6. TM 6 - Drill Press
7. TM 7 - Wood Lathe
8. TM 8 - Portable Circular Saw
9. TM 9 - Sabre Saw
10. TM 10- Belt Sander
11. TM 11- Portable Drill
12. TM 12- Finish Sander (Vibrator)
13. TM 13- Router

D. Job sheets

1. Job sheet #1 - Crosscutting With The Table Saw or Bench Saw
2. Job sheet #2 - Ripping With The Table Saw or Bench Saw
3. Job sheet #3 - Crosscutting With The Radial Arm Saw
4. Job sheet #4 - Crosscutting With An Electrical Hand Saw

E. Test

F. Answers to test

II. References:

A. Boyd, James S., Practical Farm Building, Danville, Illinois, The Interstate Printers and Publishers, Inc., 1973.

B. Wakeman and McCoy, The Farm Shop, New York, New York, The MacMillan Co., 1960.

C. Power Tool Safety and Operation, Hobar Publishers, 1974.

POWER TOOLS

INFORMATION SHEET

I. Terms and definitions:

A. TABLE SAW OR BENCH SAW - Used primarily for crosscutting and straight ripping.

B. RADIAL ARM SAW - Adapted primarily for crosscutting, cutting angles and miters.

C. BAND SAW - Is used for cutting circles, curves and various special designs.

D. JOINTER - Is designed for jointing edges of boards and for rabbeting.

E. THICKNESS PLANNER - Used to surface lumber to a desired thickness.

F. DRILL PRESS - Is used for boring, mortising and routing.

G. WOOD LATHE - Is used to turn stock to a desired shape or special design.

H. ELECTRIC HAND SAW - Is designed to do most cutting jobs anywhere on the building, such as ripping, crosscutting and cutting angles.

I. SABRE SAW - Is designed to use a variety of blades that can make cuts that a circular saw cannot.

J. PORTABLE BELT SANDER - Used for sanding any size surface and inaccessible place by means of a revolving belt.

K. ELECTRIC HAND DRILL - Is used for boring holes that cannot be bored with a drill press.

L. VIBRATING SANDER - Used for sanding any size surface and inaccessible place by means of a vibrating or oscillating sanding pad.

M. ROUTER - Is used to cut rabbets, grooving, shaping and trimming laminates.

II. Seven types of stationary power tools and six types of hand operated or portable power tools.

A. Stationary Power Tools

1. Table Saw or Bench Saw

INFORMATION SHEET

2. Radial Arm Saw

3. Band Saw

4. Jointer

5. Thickness Planner

6. Drill Press

7. Wood Lathe

B. Portable Power Tools

1. Electric Hand Saw

2. Sabre Saw

3. Portable Belt Sander

4. Electric Hand Drill

5. Vibrating Hand Drill

6. Router

III. Basic operations or jobs for the thirteen respective power tools.

A. Table Saw or Bench Saw. TM 1

1. Crosscutting

2. Ripping

3. Dadoing

4. Beveling

5. Mitering

B. Radial Arm Saw. TM 2

1. Mitering

2. Dadoing

3. Ripping

4. Crosscutting

5. Compound Mitering

INFORMATION SHEET

   6. Rabbeting

C. Band Saw. TM 3
   1. Curves (irregular)
   2. Circles
   3. Ripping

D. Jointer. TM 4
   1. Edge planning
   2. Beveling
   3. Tapering
   4. Rabbeting
   5. Face planning
   6. Chamferring

E. Thickness Planner. TM 5
   1. Face Planning
   2. Planning to a desired thickness

F. Drill Press. TM 6
   1. Boring and drilling holes
   2. Mortising
   3. Routing
   4. Shaping

G. Wood Lathe. TM 7
   1. Spindle turning
   2. Face plate turning

H. Electric Hand Saw. TM 8
   1. Ripping
   2. Crosscutting

INFORMATION SHEET

3. Beveling
4. Mitering

I. Saber Saw. TM 9

1. Crosscutting
2. Ripping
3. Cutting curves or irregular shapes
4. Internal cutting

J. Portable Belt Sander. TM 10

1. Edge Sanding
2. Face Sanding

K. Electric Hand Drill. TM 11

1. Drilling and boring holes
2. Driving screws

L. Vibrating Sander. TM 12

1. Edge sanding
2. Face sanding

M. Router. TM 13

1. Shaping edges
2. Grooving
3. Trimming laminates

IV. Basic parts of the thirteen power tools.

NOTE: Refer to the transparency for each power tool for correct parts.

INFORMATION SHEET

A. Table Saw or Bench Saw. TM 1

1. Miter Gauge
2. Fence
3. Guide Bar
4. Fence Clamp
5. Fence micro-set knob
6. T-slot for Miter gauge
7. Switch
8. Clean-out
9. Saw Guard
10. Blade Insert
11. Table
12. Tilt Scale
13. Raising Handle Reel
14. Tilt Hand Wheel
15. Lock Knob

B. Radial Arm Saw. TM 2

1. Miter Scale
2. Swivel Latch
3. Centilevel Arm
4. Yoke
5. On-Off Switch
6. Bevel Latch
7. Bevel Scale
8. Kick Back Guard
9. Elevating Handle
10. Arm Clamp Handle
11. Miter Latch
12. Circular column
13. Self-Adjusting Blade Guards
14. Metal Base
15. Fence

C. Band Saw. TM 3

1. Ball Bearing Blade Support
2. Lamp Attachment
3. Guide Post
4. Blade Support Lock Screw
5. Blade Guide Lock Screw
6. Blade
7. Table Insert

INFORMATION SHEET

12. Tilt Angle Scale
13. Tilting Table
14. Lower Table or Base

G. Wood Lathe. TM 7

1. Tailstock Locking Clamp
2. Hand Wheel
3. Spindle Lock
4. Spindle
5. Tailstock
6. Bed
7. Steel Cabinet
8. Locking Handle for Tool Support Bar
9. Calibrated Tool Support
10. Tool Support Base
11. Head Stock Spindle
12. Switch
13. Headstock
14. Indexing Pin
15. Hand Wheel
16. Speed Control Hand Wheel
17. Variable Speed Dial

H. Electric Hand Saw. TM 8

1. Handle
2. Power cord
3. Guide Knob
4. Angle Scale
5. Tilt Lock Knob
6. Rip Guide Lock Knob
7. Tilting Base
8. Anti-Kickback Clutch
9. Trigger Switch
10. Guard Lift Handle
11. Retractable Guard
12. Blade

I. Sabre Saw. TM 9

1. Cord Strain Reliever
2. Handle
3. Brushes
4. Base Tile Adjustment
5. Tilting Base
6. On-Off Switch
7. Guide Knob
8. Aluminum Housing

INFORMATION SHEET

9. Blade Screw
10. Toe
11. Blade

J. Belt Sander. TM 10

1. Dust Bag
2. Switch Lock
3. D-Handle
4. Trigger Switch
5. Brush Holder
6. Front Handle
7. Aluminum Housing
8. Belt
9. Belt Striker Bar
10. Belt Tracking Adjustment

K. Electric Hand Drill. TM 11

1. Aluminum Housing
2. Pistol Grip Handle
3. Cord Strain Reliever
4. Geared
5. Cooling Vents
6. Reversing Switch
7. Trigger Switch
8. Switch Lock
9. Chuck Wrench

L. Vibrator Sander. TM 12

1. Brush Holder
2. Switch Lock
3. Insulated Trigger Switch
4. Contoured Handle
5. Cord Strain Reliever
6. Sub-Base
7. D-Handle
8. Motor Safety Disconnect

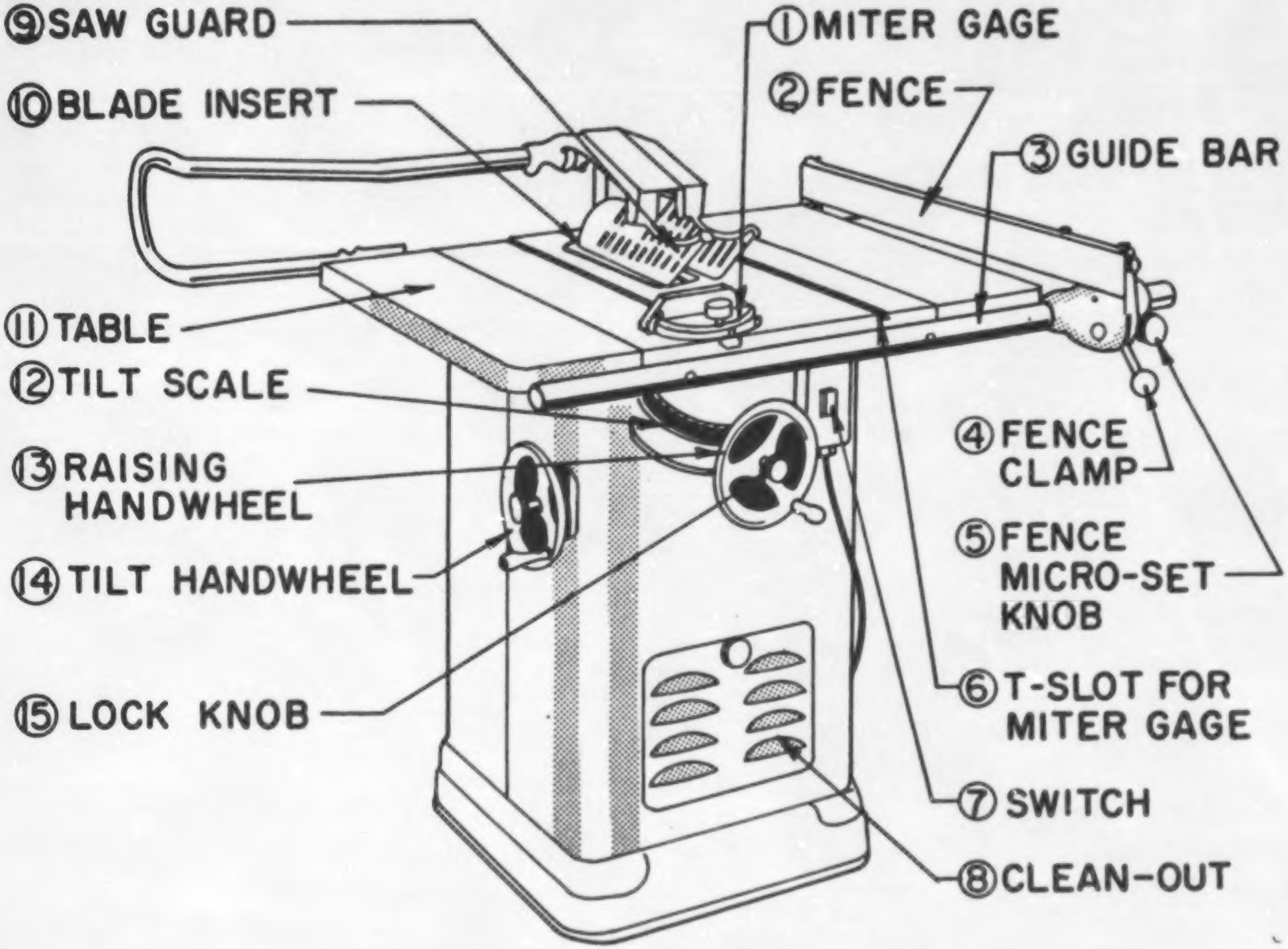
M. Router. TM 13

1. Brushes
2. Aluminum Housing
3. Micrometer Depth Adjustment
4. Guide Knob
5. Locking Handle
6. Motor Cooling Fan
7. Sub-Base
8. D-Handle
9. Insulated Trigger Switch

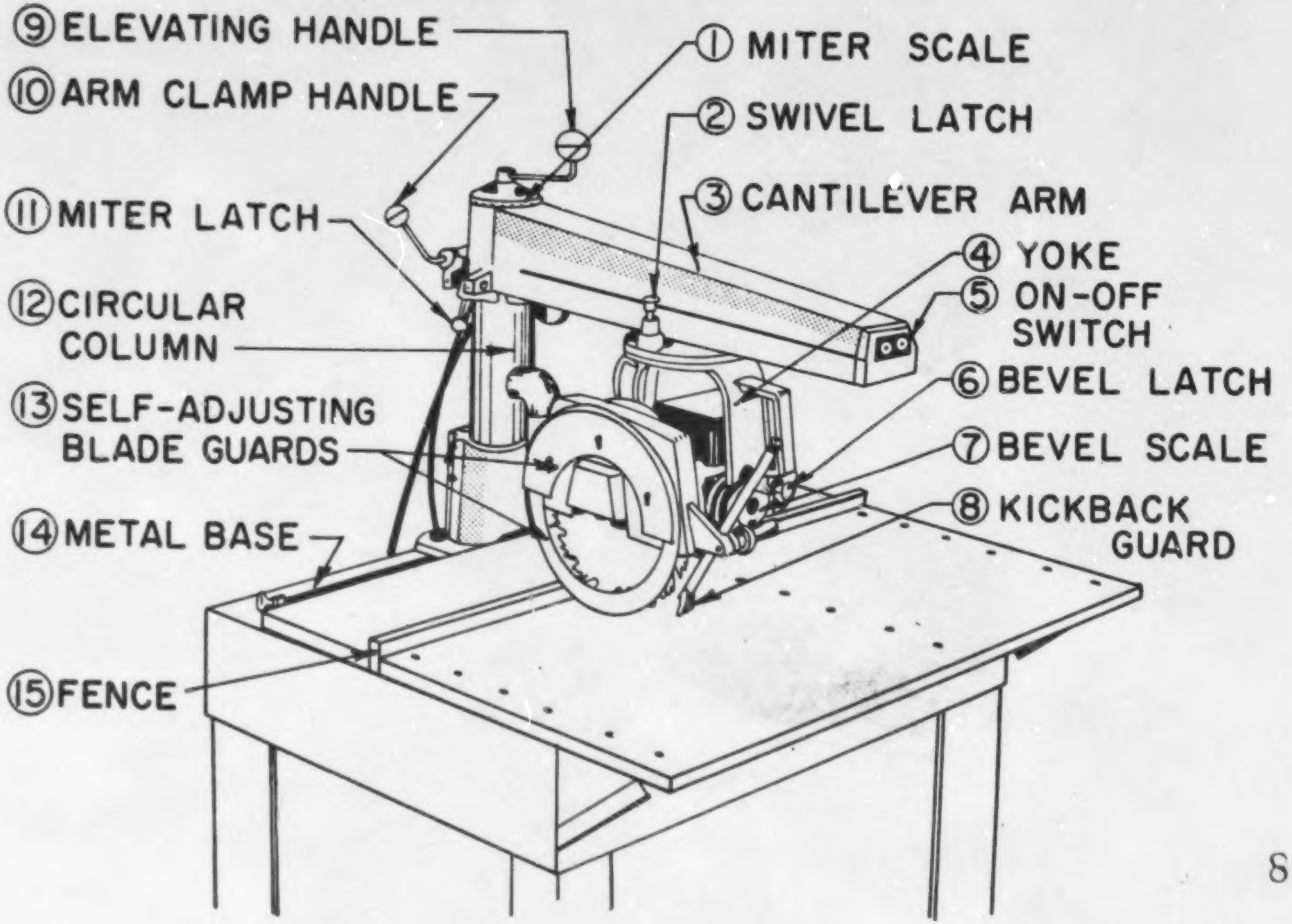
INFORMATION SHEET

10. Motor Safety Disconnect
11. Cord Strain Reliever
12. Collet Type Chuck

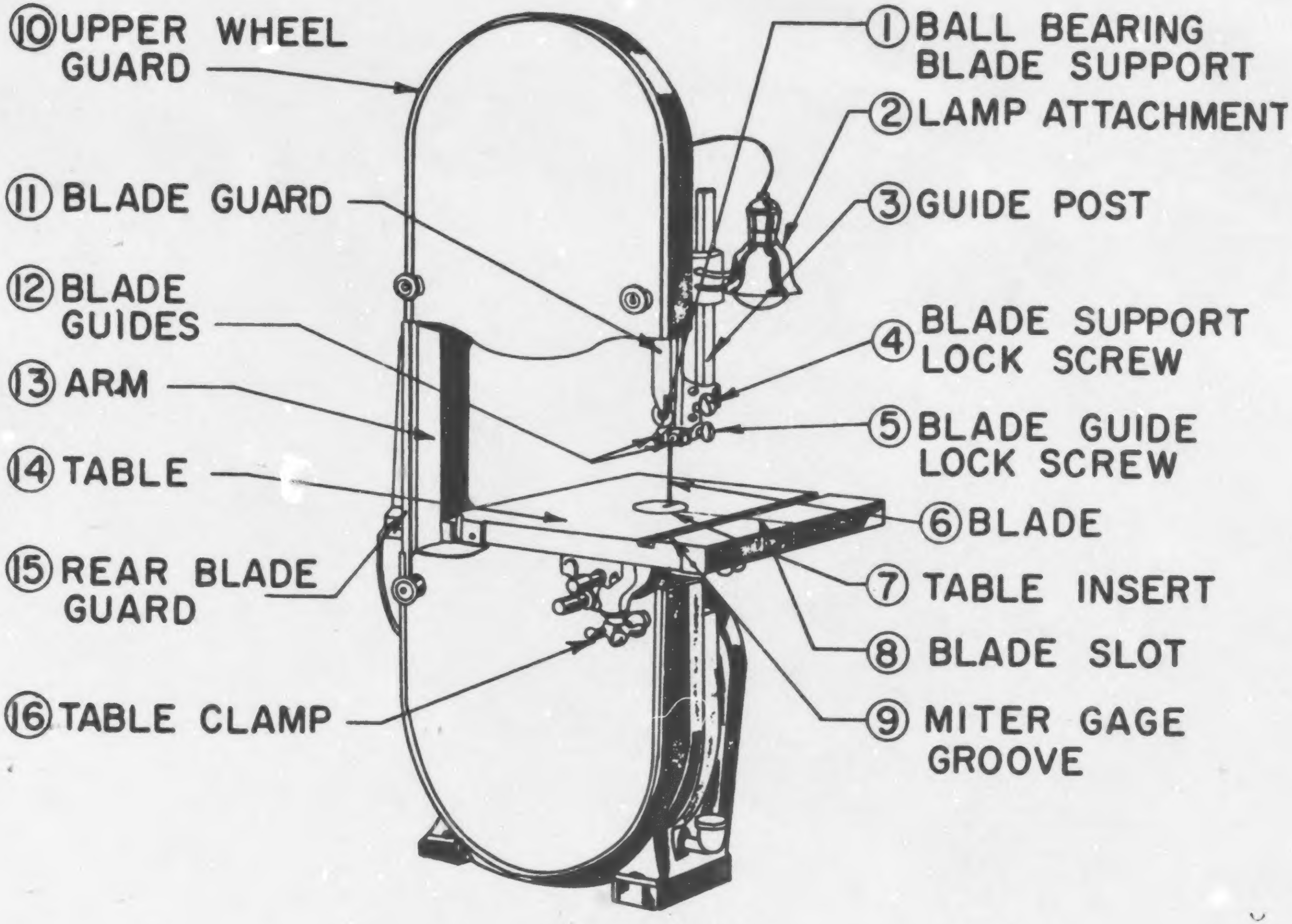
BENCH SAW


⑨ SAW GUARD
⑩ BLADE INSERT
⑪ TABLE
⑫ TILT SCALE
⑬ RAISING HANDWHEEL
⑭ TILT HANDWHEEL
⑮ LOCK KNOB
① MITER GAGE
② FENCE
③ GUIDE BAR
④ FENCE CLAMP
⑤ FENCE MICRO-SET KNOB
⑥ T-SLOT FOR MITER GAGE
⑦ SWITCH
⑧ CLEAN-OUT

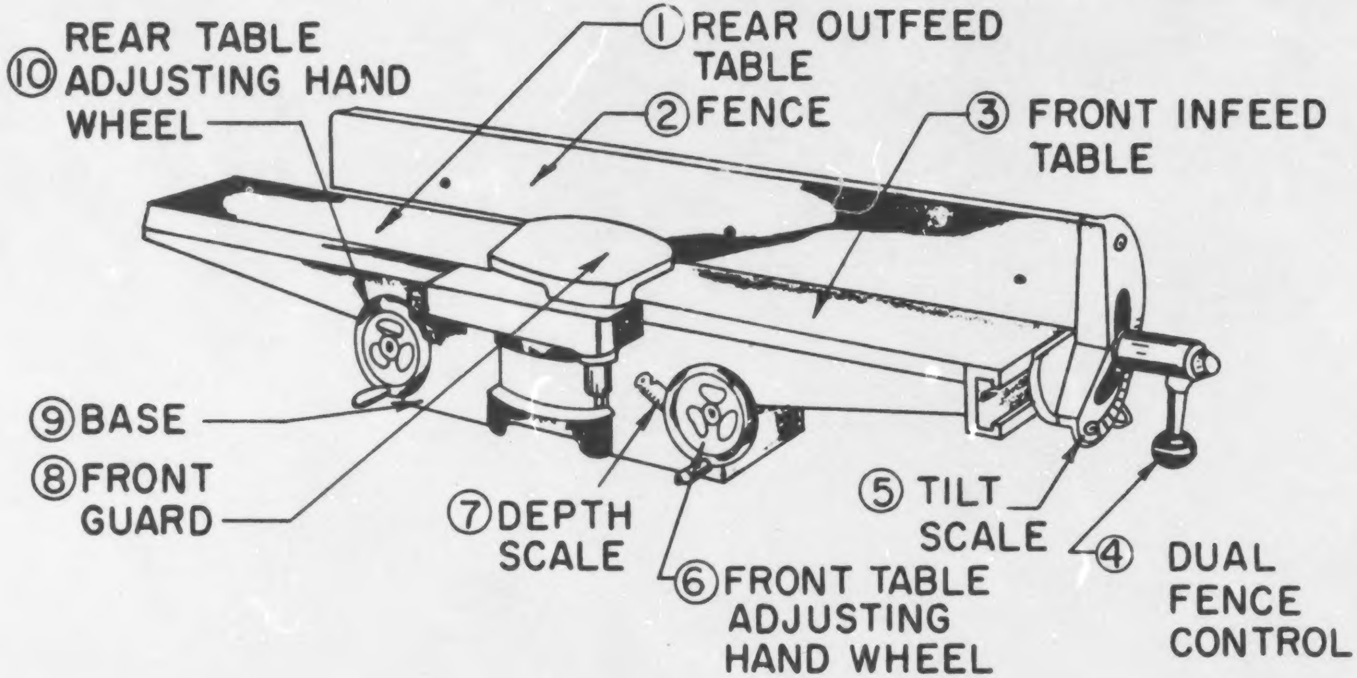
RADIAL ARM SAW


⑨ELEVATING HANDLE
⑩ARM CLAMP HANDLE
⑪MITER LATCH
⑫CIRCULAR COLUMN
⑬SELF-ADJUSTING BLADE GUARDS
⑭METAL BASE
⑮FENCE
① MITER SCALE
② SWIVEL LATCH
③ CANTILEVER ARM
④ YOKE
⑤ ON-OFF SWITCH
⑥ BEVEL LATCH
⑦ BEVEL SCALE
⑧ KICKBACK GUARD

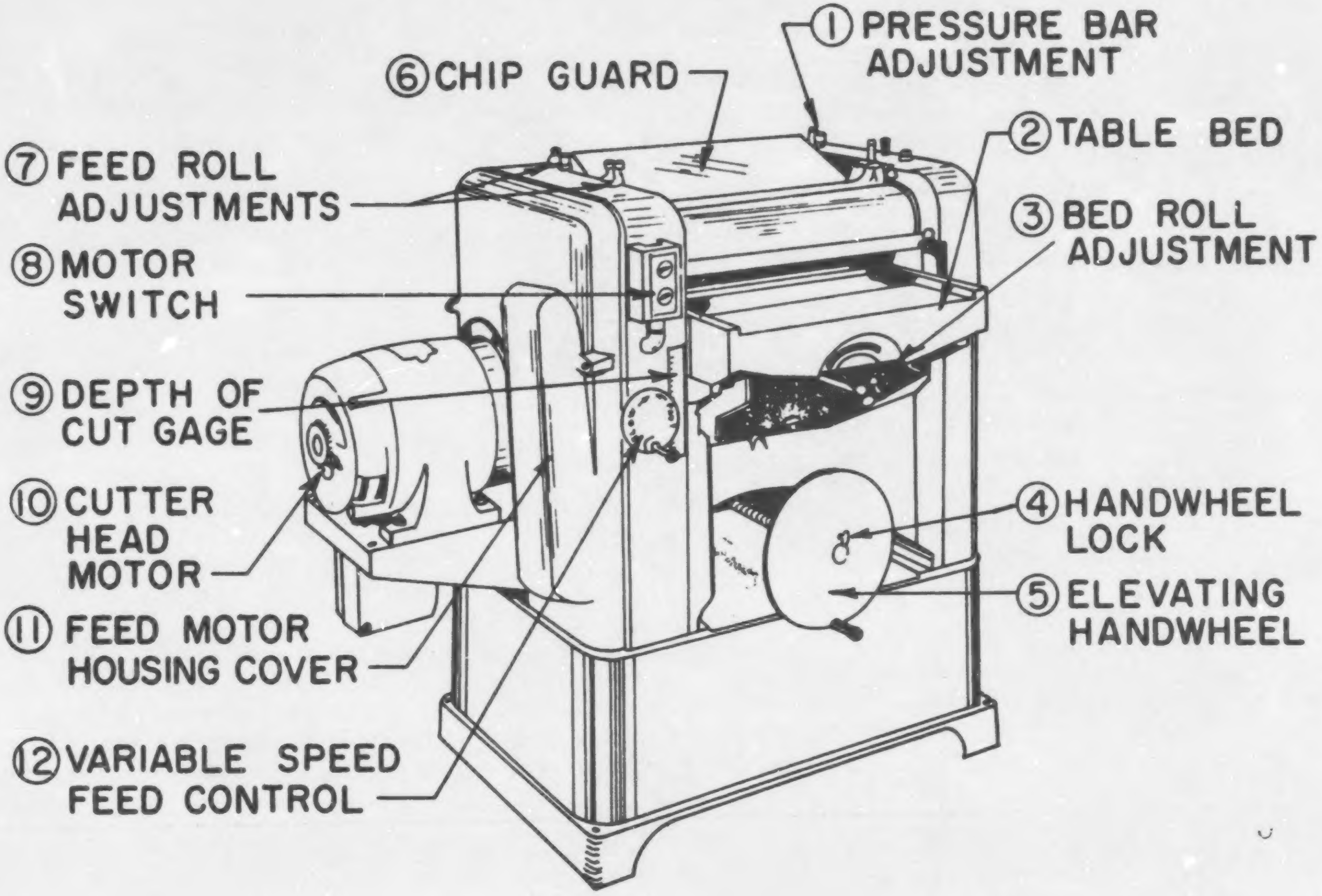
BAND SAW


⑩ UPPER WHEEL GUARD
① BALL BEARING BLADE SUPPORT
② LAMP ATTACHMENT
⑪ BLADE GUARD
③ GUIDE POST
⑫ BLADE GUIDES
④ BLADE SUPPORT LOCK SCREW
⑬ ARM
⑤ BLADE GUIDE LOCK SCREW
⑭ TABLE
⑥ BLADE
⑮ REAR BLADE GUARD
⑦ TABLE INSERT
⑧ BLADE SLOT
⑯ TABLE CLAMP
⑨ MITER GAGE GROOVE

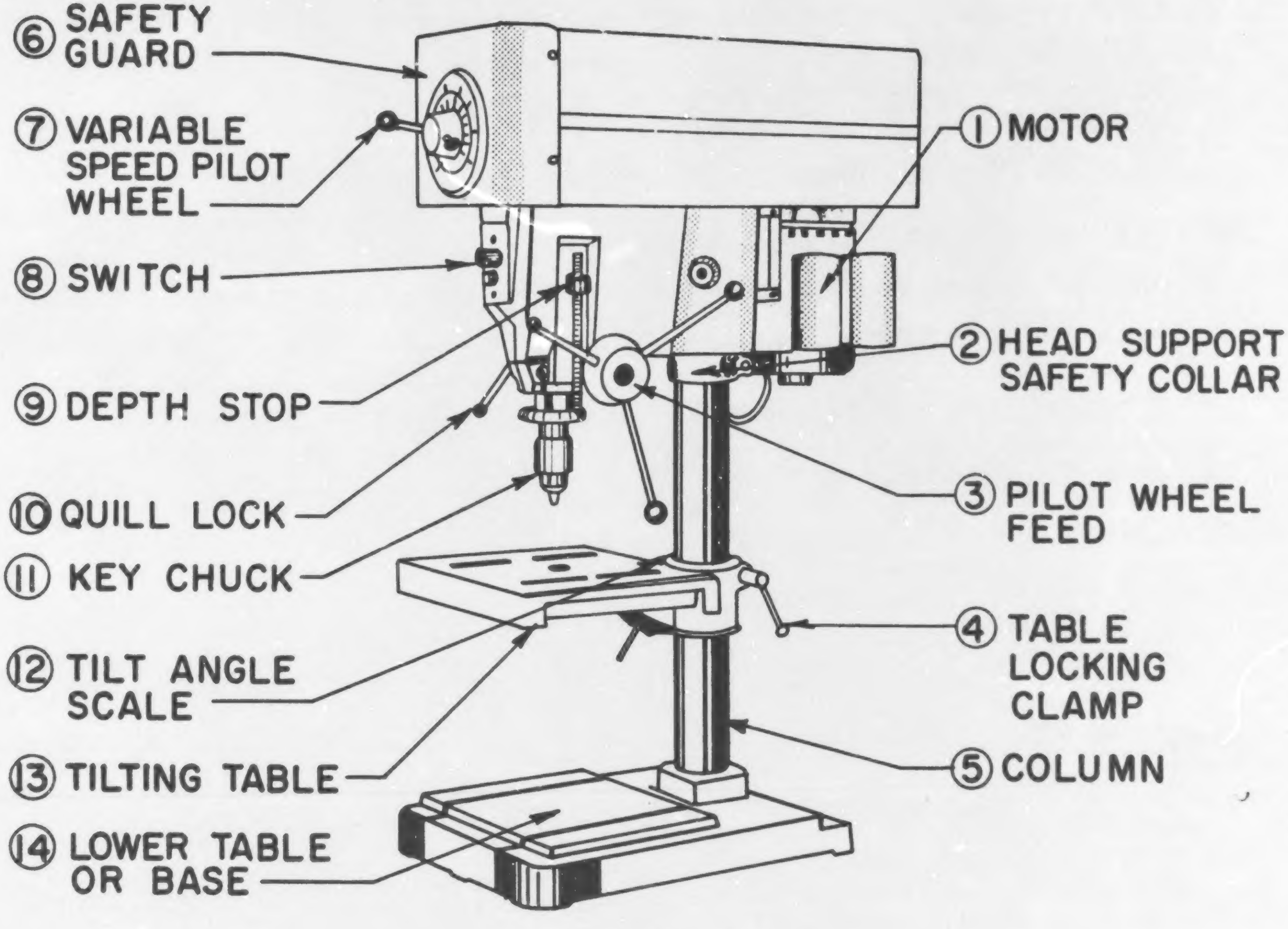
JOINTER


① REAR OUTFEED TABLE
② FENCE
③ FRONT INFEED TABLE
④ DUAL FENCE CONTROL
⑤ TILT SCALE
⑥ FRONT TABLE ADJUSTING HAND WHEEL
⑦ DEPTH SCALE
⑧ FRONT GUARD
⑨ BASE
⑩ REAR TABLE ADJUSTING HAND WHEEL

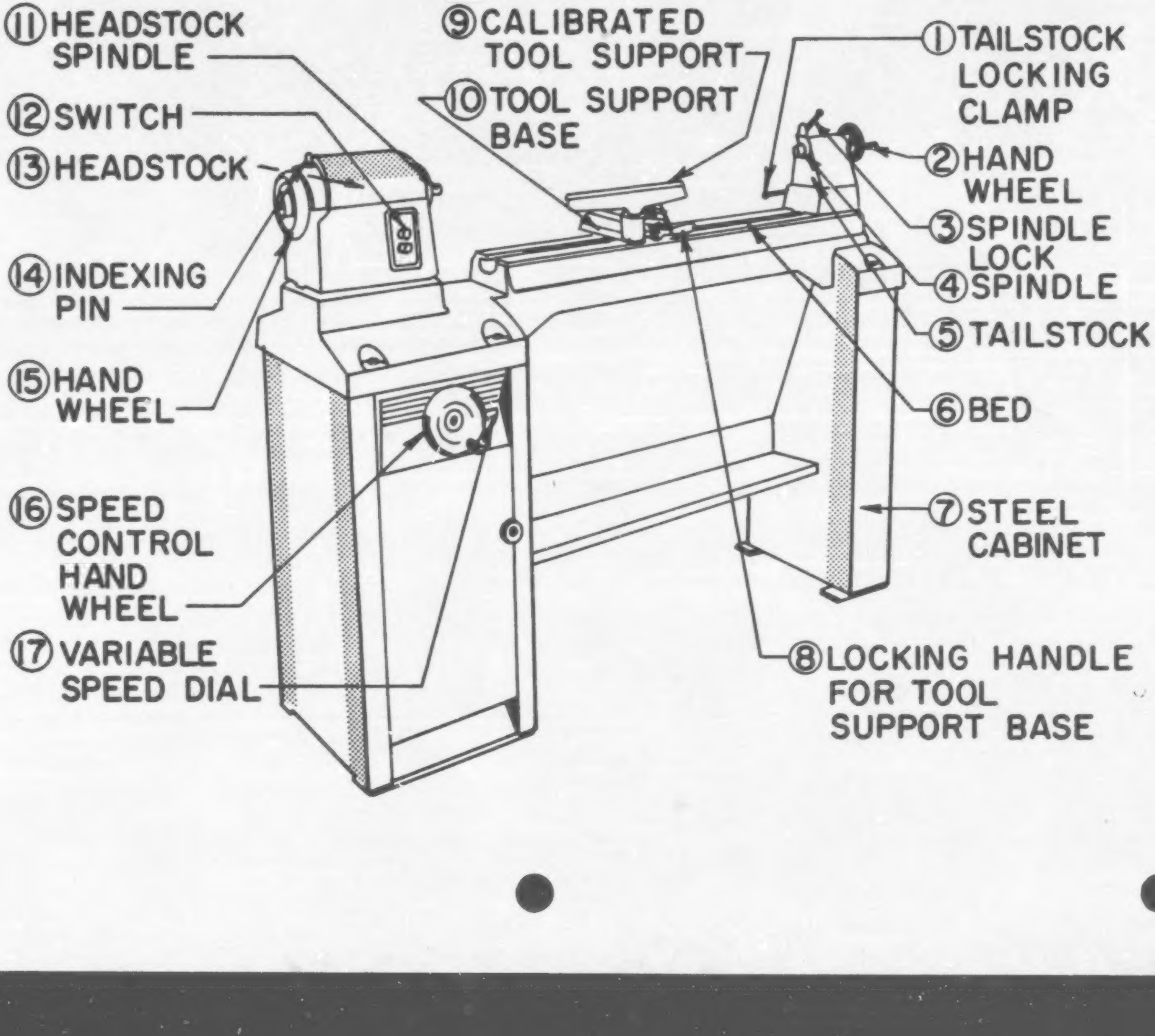
PLANER SURFACER


① PRESSURE BAR ADJUSTMENT
② TABLE BED
③ BED ROLL ADJUSTMENT
④ HANDWHEEL LOCK
⑤ ELEVATING HANDWHEEL
⑥ CHIP GUARD
⑦ FEED ROLL ADJUSTMENTS
⑧ MOTOR SWITCH
⑨ DEPTH OF CUT GAGE
⑩ CUTTER HEAD MOTOR
⑪ FEED MOTOR HOUSING COVER
⑫ VARIABLE SPEED FEED CONTROL

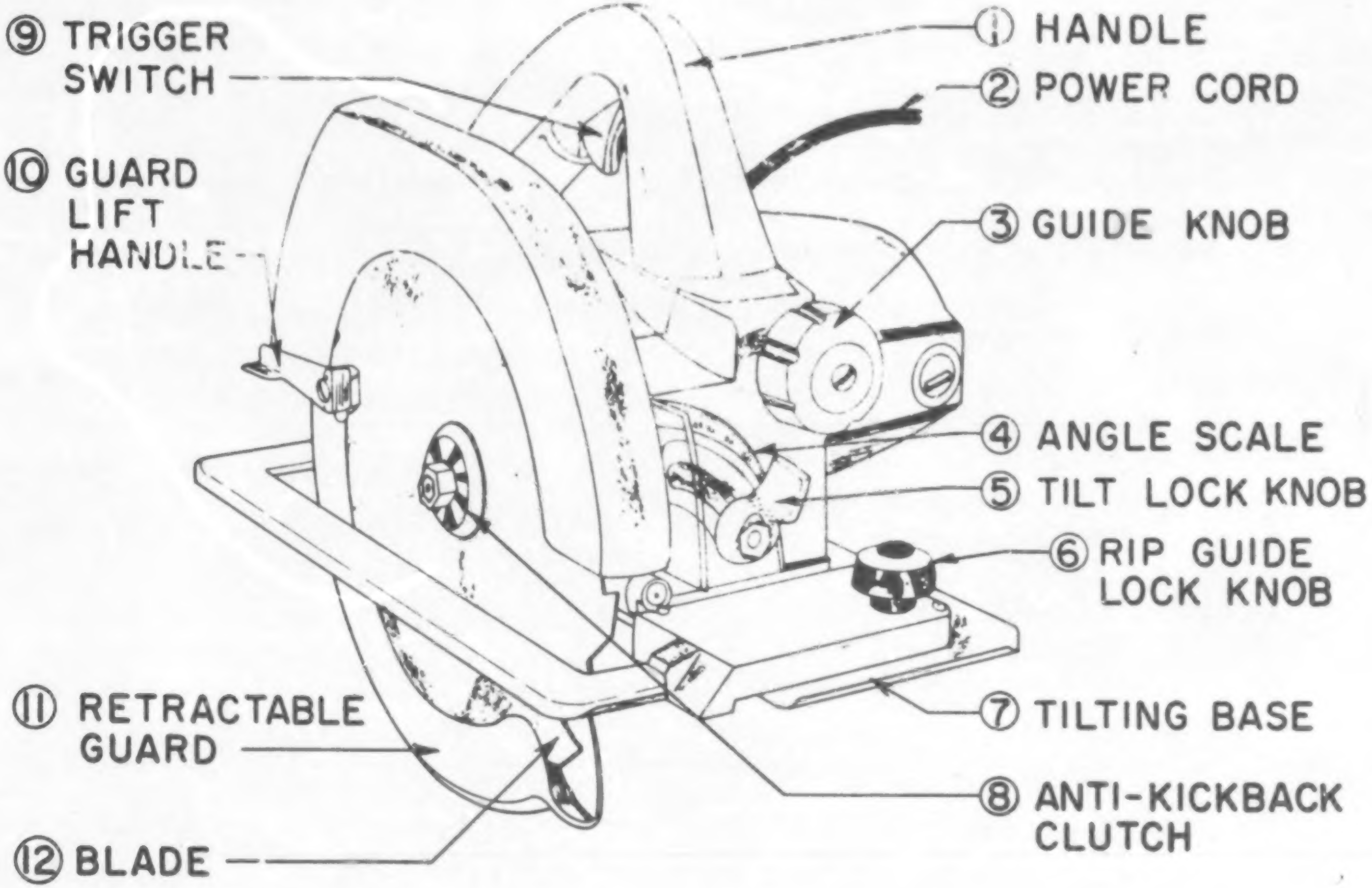
DRILL PRESS


⑥ SAFETY GUARD
⑦ VARIABLE SPEED PILOT WHEEL
⑧ SWITCH
⑨ DEPTH STOP
⑩ QUILL LOCK
⑪ KEY CHUCK
⑫ TILT ANGLE SCALE
⑬ TILTING TABLE
⑭ LOWER TABLE OR BASE
① MOTOR
② HEAD SUPPORT SAFETY COLLAR
③ PILOT WHEEL FEED
④ TABLE LOCKING CLAMP
⑤ COLUMN

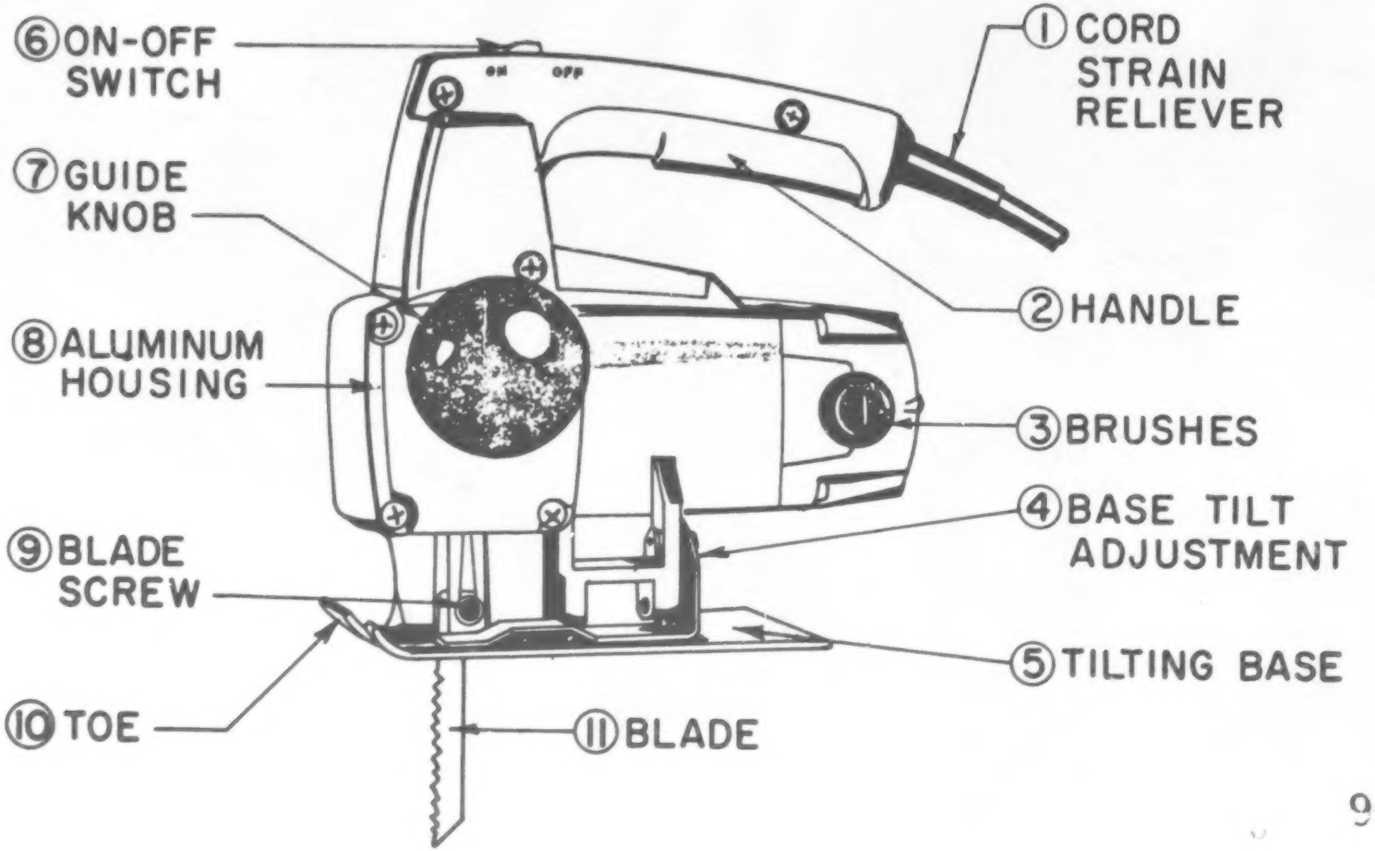
WOOD LATHE


⑪ HEADSTOCK SPINDLE
⑫ SWITCH
⑬ HEADSTOCK
⑭ INDEXING PIN
⑮ HAND WHEEL
⑯ SPEED CONTROL HAND WHEEL
⑰ VARIABLE SPEED DIAL
⑨ CALIBRATED TOOL SUPPORT
⑩ TOOL SUPPORT BASE
① TAILSTOCK LOCKING CLAMP
② HAND WHEEL
③ SPINDLE LOCK
④ SPINDLE
⑤ TAILSTOCK
⑥ BED
⑦ STEEL CABINET
⑧ LOCKING HANDLE FOR TOOL SUPPORT BASE

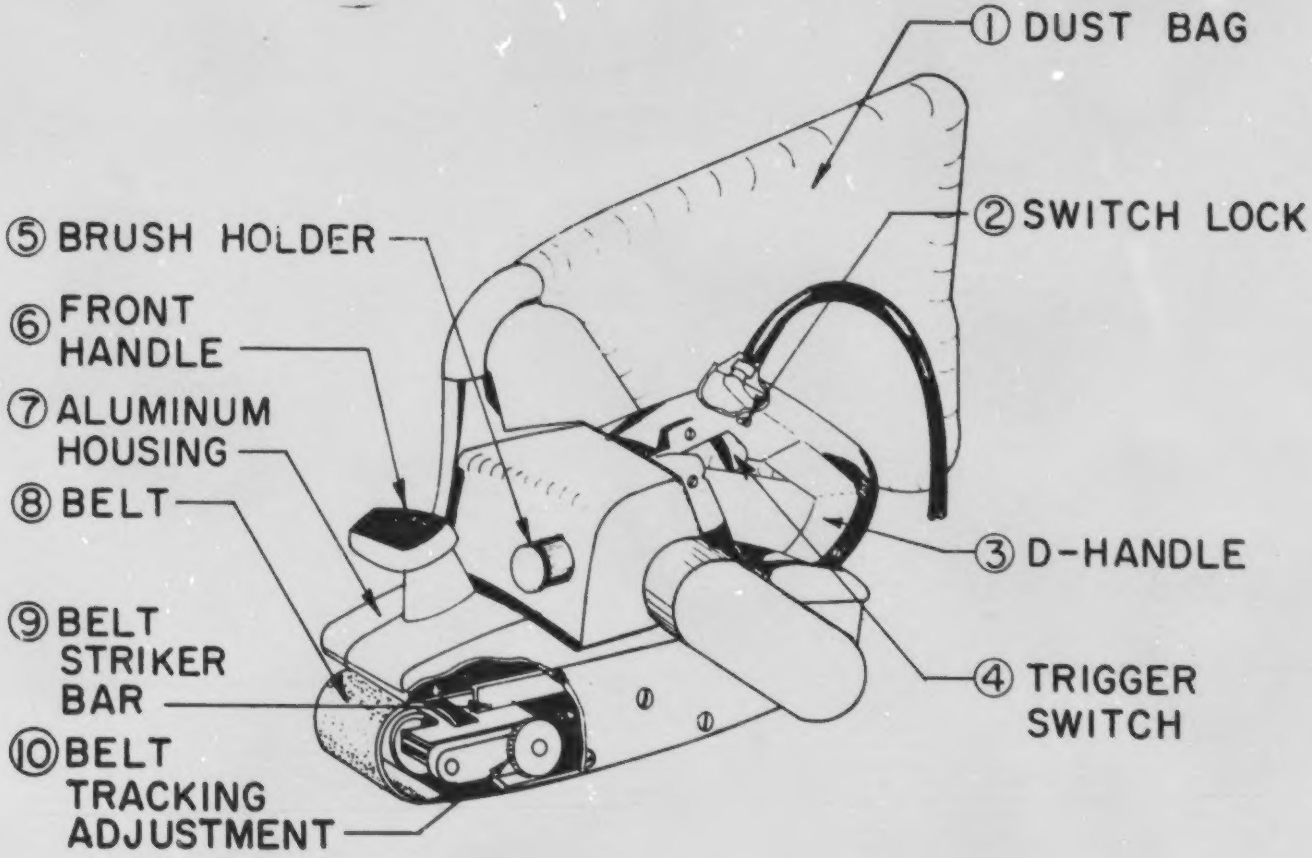
PORTABLE CIRCULAR SAW


① HANDLE
② POWER CORD
③ GUIDE KNOB
④ ANGLE SCALE
⑤ TILT LOCK KNOB
⑥ RIP GUIDE LOCK KNOB
⑦ TILTING BASE
⑧ ANTI-KICKBACK CLUTCH
⑨ TRIGGER SWITCH
⑩ GUARD LIFT HANDLE
⑪ RETRACTABLE GUARD
⑫ BLADE

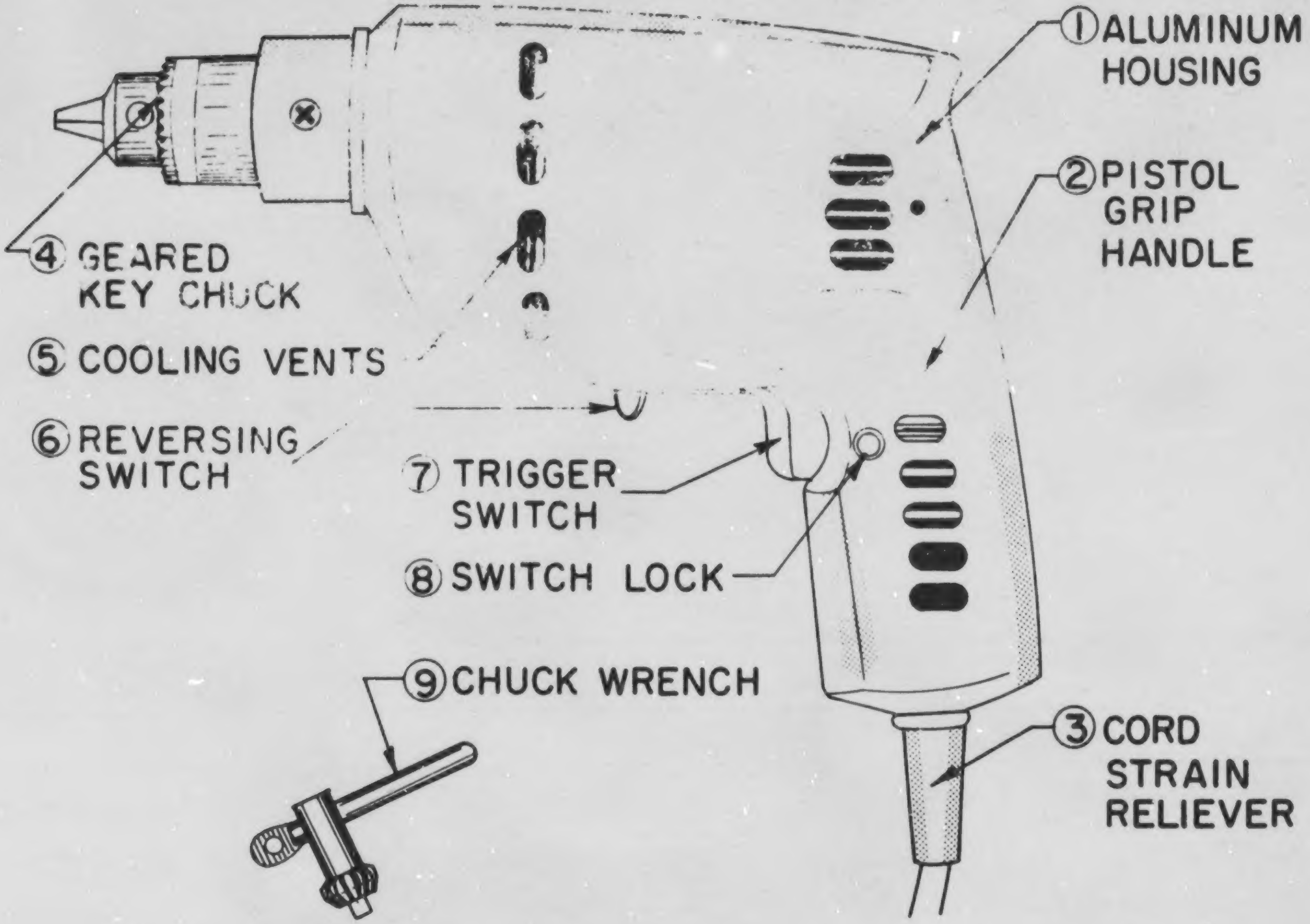
SABRE SAW


⑥ON-OFF SWITCH
ON
OFF
①CORD STRAIN RELIEVER
⑦GUIDE KNOB
②HANDLE
⑧ALUMINUM HOUSING
③BRUSHES
④BASE TILT ADJUSTMENT
⑨BLADE SCREW
⑤TILTING BASE
⑩TOE
⑪BLADE

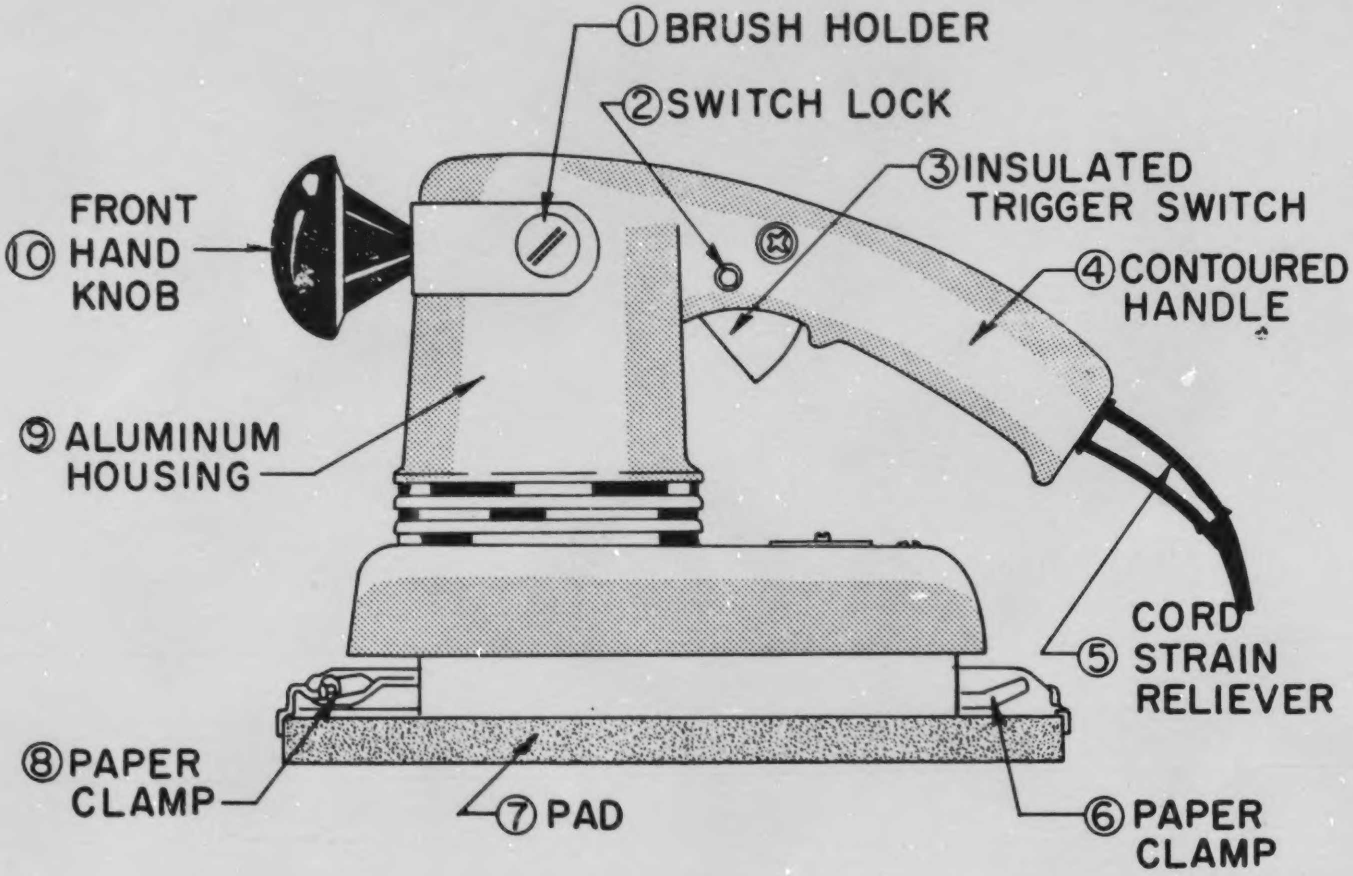
BELT SANDER


① DUST BAG
② SWITCH LOCK
③ D-HANDLE
④ TRIGGER SWITCH
⑤ BRUSH HOLDER
⑥ FRONT HANDLE
⑦ ALUMINUM HOUSING
⑧ BELT
⑨ BELT STRIKER BAR
⑩ BELT TRACKING ADJUSTMENT

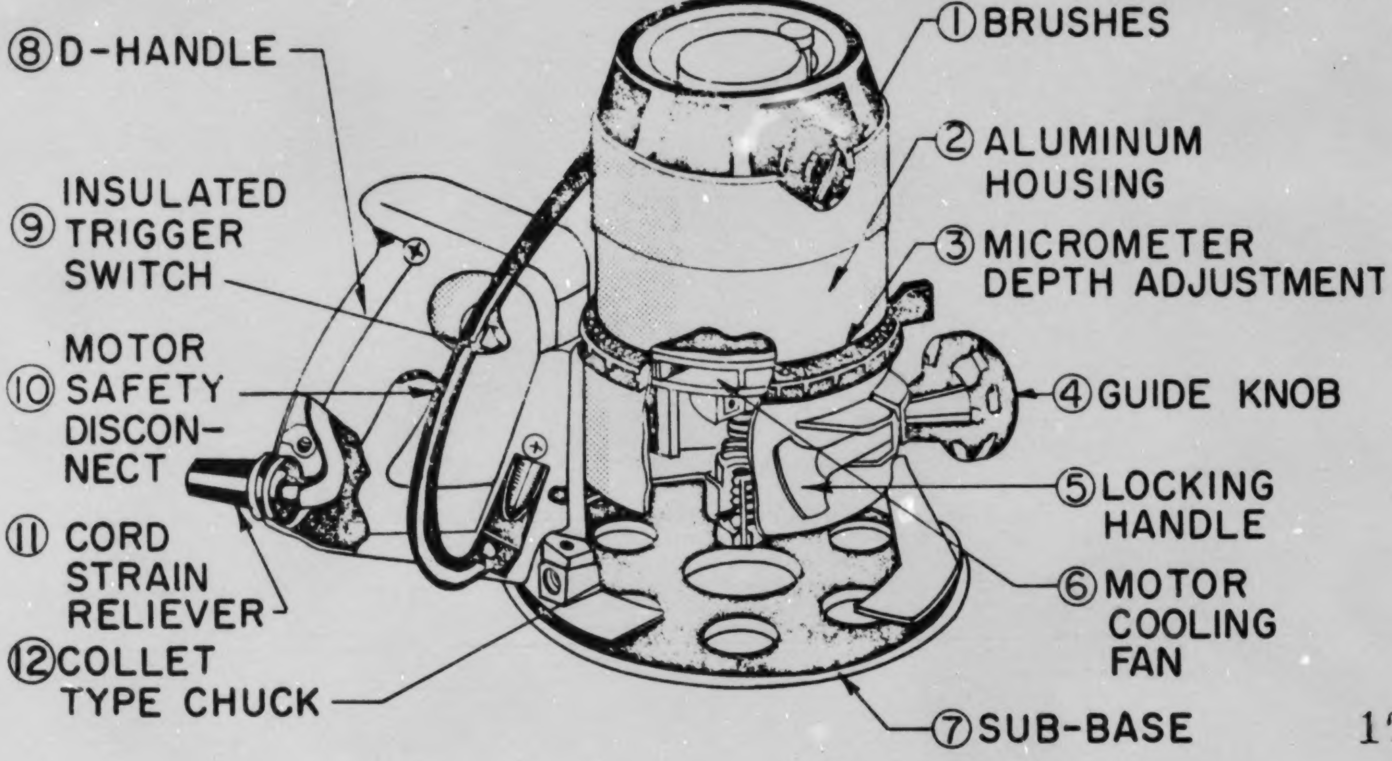
PORTABLE DRILL


① ALUMINUM HOUSING
② PISTOL GRIP HANDLE
③ CORD STRAIN RELIEVER
④ GEARED KEY CHUCK
⑤ COOLING VENTS
⑥ REVERSING SWITCH
⑦ TRIGGER SWITCH
⑧ SWITCH LOCK
⑨ CHUCK WRENCH

FINISHING SANDER


①BRUSH HOLDER
②SWITCH LOCK
③INSULATED TRIGGER SWITCH
④CONTOURED HANDLE
⑤CORD STRAIN RELIEVER
⑥PAPER CLAMP
⑦PAD
⑧PAPER CLAMP
⑨ALUMINUM HOUSING
⑩FRONT HAND KNOB

ROUTER


① BRUSHES
② ALUMINUM HOUSING
③ MICROMETER DEPTH ADJUSTMENT
④ GUIDE KNOB
⑤ LOCKING HANDLE
⑥ MOTOR COOLING FAN
⑦ SUB-BASE
⑧ D-HANDLE
⑨ INSULATED TRIGGER SWITCH
⑩ MOTOR SAFETY DISCONNECT
⑪ CORD STRAIN RELIEVER
⑫ COLLET TYPE CHUCK

POWER TOOLS

JOB SHEET #1 - CROSSCUTTING WITH THE TABLE SAW OR BENCH SAW

I. Materials needed:

- A. Safety shield
- B. Miter gauge
- C. 1" X 4" X 2' piece of lumber
- D. Pencil
- E. Tape or square for measuring

II. Procedure:

- A. Properly secure one piece of lumber from the instructor.
- B. Mark and square material two inches from one end.
- C. Use a combination,crosscut or carbon tooth blade.
- D. Adjust the depth of cut so that the blade clears the material by the depth of the teeth.
- E. Place the miter gauge in position.
- F. Do not use the fence as a guide when crosscutting.
- G. Position the board against the miter gauge and align the mark up with the cutting line of the blade.
- H. With the safety shield in place, turn the machine on.
- I. Proceed with caution being careful not to force the work.

AS - 43-C

POWER TOOLS

JOB SHEET #2 - RIPPING WITH THE TABLE SAW OR BENCH SAW

I. Materials needed:

   A. Safety shield

   B. Fence (ripping)

   C. 1" X 4" X 2' piece of lumber

   D. Square (framing)

II. Procedure:

   A. Properly secure one piece of lumber from instructor.

   B. Use a combination,ripping or carbon tooth blade.

   C. Place the ripping fence in place.

   D. By measuring from the fence to the outer side of the teeth, set fence to rip off 1" of the board.

   E. Use push stick when ripping narrow stock.

   F. Be sure guards are in place.

   G. Adjust blade to proper height (the height of the tooth above material).

   H. With the safety shield in place, turn machine on.

   I. Proceed with caution being careful not to force material.

POWER TOOLS

JOB SHEET #3 - CROSSCUTTING WITH THE RADIAL ARM SAW

I. Materials needed:

- A. Safety shield
- B. 1" X 4" X 2' lumber
- C. Pencil
- D. Tape or square for measuring

II. Procedure:

- A. Properly secure lumber from the instructor.
- B. Mark and square material 3" from one end.
- C. Use a combination,crosscut or carbon tooth blade.
- D. Adjust the height of the blade by turning the elevating handle until the teeth just touch the table top.
- E. Adjust the saw to a right angle to the fence and perpendicular to the table.
- F. Place the material with the straightest side against the fence and align the mark with the blade.
- G. Being sure that blade is not engaging the material, start the saw and release the rip lock.
- H. Hold the material with the left hand and saw with the right hand and stand just to the left of the blade.
- I. Pull the saw toward the operator slowly enough that the saw does not grab.
- J. Return saw to the rear, lock in place and stop the saw.

POWER TOOLS

JOB SHEET #4 - CROSSCUTTING WITH A ELECTRIC HAND SAW

I. Materials needed:

   A. Safety shield

   B. 1" X 6" X 2' lumber

   C. Pencil

   D. Tape or square for measuring

II. Procedure:

   A. Properly secure lumber from the instructor.

   B. Mark and square material 3" from one end.

   C. Use a combination, crosscut or carbon tooth blade.

   NOTE: Do not change blade or make any type of adjustment until the electrical cord has been disconnected.

   D. Make sure material is supported solidly and not between two supports.

   E. Adjust the depth of cut so that teeth clear the thickness of material by the depth of the teeth.

   F. Grasp handle firmly, place base of saw on material, align the blade with mark and do not place finger on trigger until ready to start.

   G. Following the line, advance the saw into the wood, sawing the cutting line.

   H. If the saw stalls, do not release the trigger but back the saw out or check if saw is binding from attempting to wedge or turn in cut.

   I. When end of cut is reached, follow through as the saw is lifted away and release the trigger.

POWER TOOLS

TEST

I. Match the terms below to the correct definition.

1. Designed to do most cutting jobs anywhere on the building such as ripping, crosscutting and cutting angles.
2. Used to surface lumber to a desired thickness.
3. Used primarily for crosscutting and straight ripping.
4. Is designed for jointing edges of boards and for rabbeting.
5. Is used for boring, mortising and routing.
6. Used for sanding any size surface and inaccessible place by means of a vibrating or oscillating sanding paper.

___A. Table Saw or Bench Saw

___B. Radial Arm Saw

___C. Band Saw

___D. Jointer

___E. Thickness Planner

___F. Drill Press

___G. Wood Lathe

___H. Electric Hand Saw

___I. Sabre Saw

___J. Portable Belt Sander

___K. Electric Hand Drill

___L. Vibrating Sander

___M. Router

7. Used to cut rabbets, grooving, shaping and trimming laminates.
8. Used for sanding any size surface and inaccessible place by means of a revolving belt.
9. Adapted primarily for crosscutting, cutting angles and miters.
10. Is used for boring holes that cannot be bored with a drill press.
11. Is used to cut circles, curves and various special designs.
12. Is used to turn stock to a desired shape or special design.
13. Is designed to use a variety of blades that can make cuts that a circular saw cannot.

II. From the list below, distinguish which of the power tools are stationary or portable by placing a "S" for stationary or "P" for portable in the correct blank.

___A. Sabre Saw

___B. Jointer

___C. Drill Press

___D. Router

___E. Band Saw

___F. Vibrating Sander

___G. Wood Lathe

___H. Belt Sander

___I. Hand Drill

___J. Table Saw or Bench Saw

___K. Electric Hand Saw

___L. Thickness Planner

___M. Radial Arm Saw

III. Match the operations or jobs below to the correct power tools.

___A. Table Saw or Bench Saw

___B. Radial Arm Saw

___C. Band Saw

___D. Jointer

___E. Thickness Planner

___F. Drill Press

___G. Wood Lathe

___H. Electric Hand Saw

___I. Portable Belt Sander

___J. Sabre Saw

___K. Electric Hand Drill

___L. Vibrating Sander

___M. Router

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1. Dadoing
2. Bevels
3. Ripping
4. Crosscutting
5. Mitering
6. Compound Mitering
7. Rabbeting
8. Curves or irregular shapes
9. Tapering
10. Face Planning
11. Chamferring
12. Circles
13. Edge Planning
14. Planning to desired thickness
15. Boring and drilling holes
16. Internal cutting
17. Spindle Turning
18. Mortising

19. Shaping

20. Edge Sanding

21. Driving Screws

22. Grooving

23. Face Sanding

24. Shaping Edges

25. Trimming Laminates

IV. Match the list of parts to the illustration of the power tools on the following pages.

A. Table Saw or Bench Saw

___a. Fence Clamp

___b. Table

___c. Lock Knob

___d. Fence

___e. Clean-out

___f. Tilt Hand Wheel

___g. Guide Bar

___h. Miter Gauge

___i. Fence Micro-Set Knob

___j. Switch

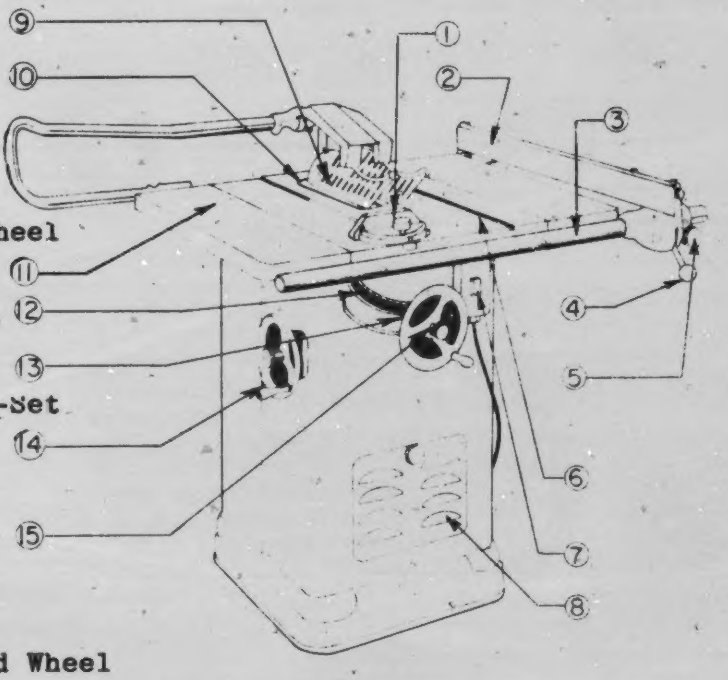
___k. Tilt Scale

___l. Saw Guard

___m. Raising Hand Wheel

___n. Blade Insert

___o. T-Slot for Miter Gauge



B. Radial Arm Saw

___a. Yoke

___b. On-Off Switch

___c. Arm Clamp Handle

___d. Circular Column

___e. Swivel Latch

___f. Bevel Scale

___g. Miter Latch

___h. Self-Adjusting Blade Guard

___i. Contilevel Arm

___j. Metal Base

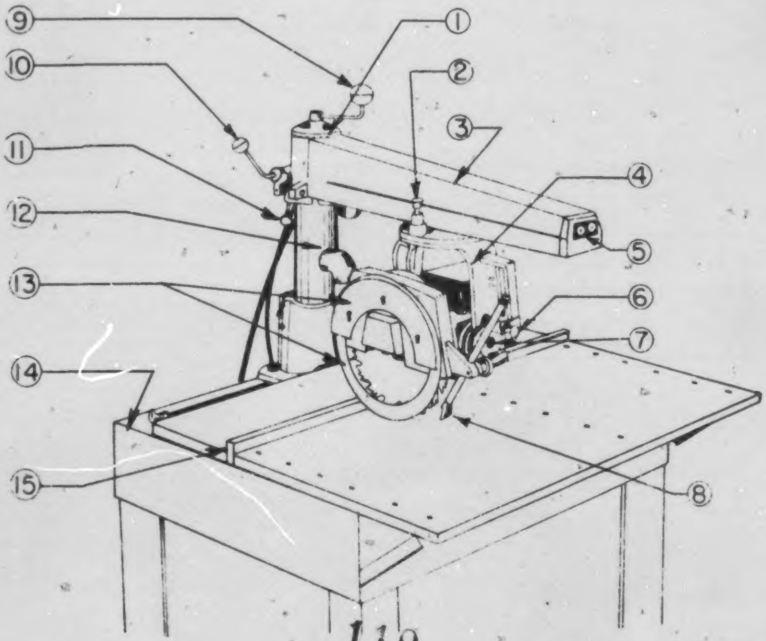
___k. Miter Scale

___l. Elevating Handle

___m. Bevel Latch

___n. Fence

___o. Kick Back Guard



C. Band Saw

___a. Blade Slot

___b. Miter Gauge Groove

___c. Table Insert

___d. Table

___e. Guide Post

___f. Arm

___g. Lamp Attachment

___h. Blade Guard

___i. Ball Bearing Blade Support

___j. Blade Support Lock Screw

___k. Upper Wheel Guard

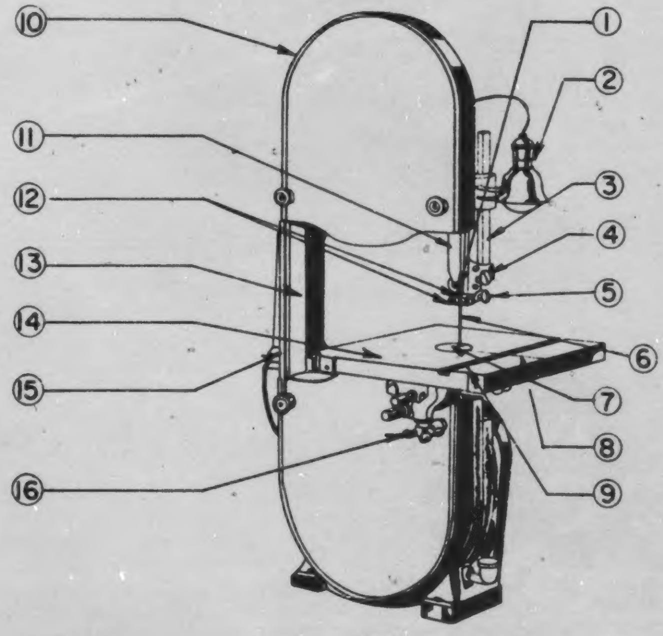
___l. Table Clamp

___m. Blade Guide Lock Screw

___n. Rear Blade Guard

___o. Blade

___p. Blade Guides



D. Jointer

___a. Base

___b. Tilt Scale

___c. Fence

___d. Front Guard

___e. Front Infeed Table

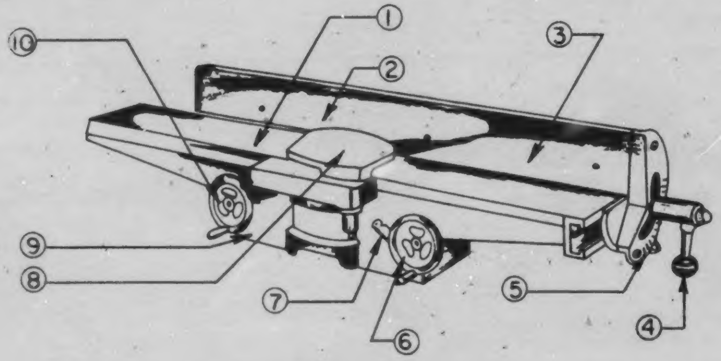
___f. Depth Scale

___g. Rear Outfeed Table

___h. Dual Fence Control

___i. Front Table Adjusting Hand Wheel

___j. Rear Table Adjusting Hand Wheel



E. Surface Planner

___a. Motor Switch

___b. Elevating Hand Wheel

___c. Feed Motor Housing Cover

___d. Table Bed

___e. Hand Wheel Lock

___f. Cutter Head Motor

___g. Chip Guard

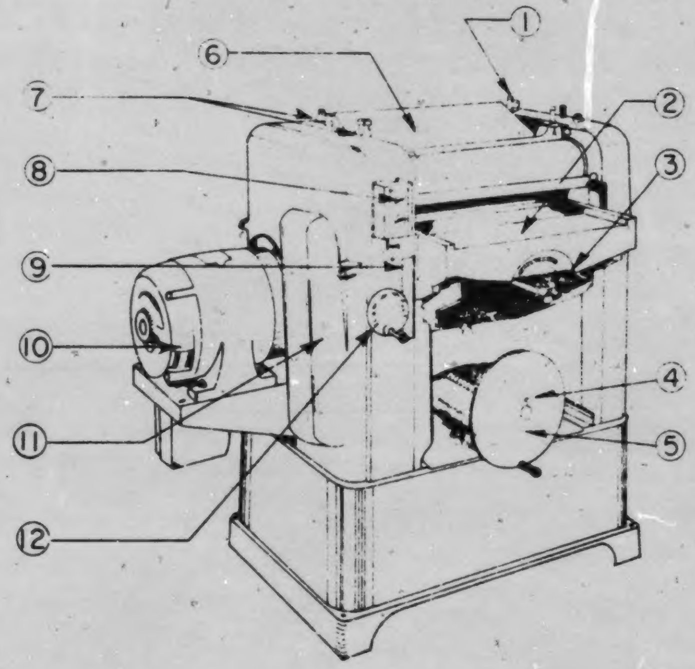
___h. Pressure Bar Adjustment

___i. Depth of Cut Gauge

___j. Feed Roll Adjustment

___k. Bed Roll Adjustment

___l. Variable Speed Feed Control



F. Drill Press

___a. Column

___b. Depth Stop

___c. Table Locking Clamp

___d. Motor

___e. Switch

___f. Tilting Table

___g. Quill Lock

___h. Head Support Safety Collar

___i. Safety Guard

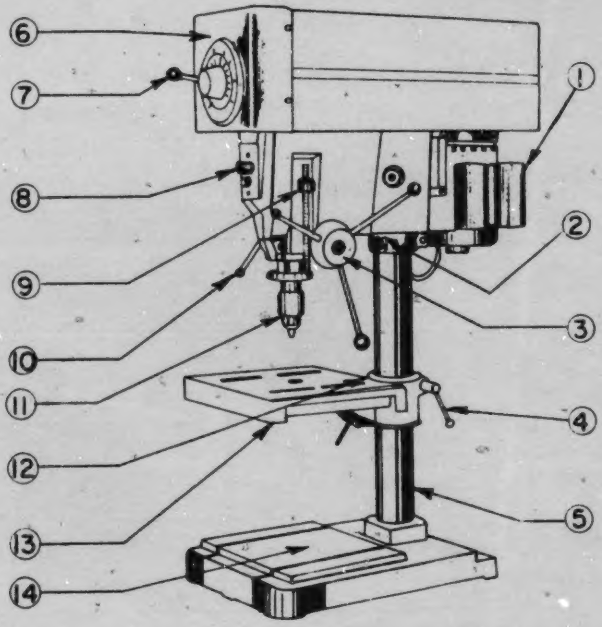
___j. Variable Speed Pilot Wheel

___k. Key Chuck

___l. Lower Table or Base

___m. Tilt Angle Scale

___n. Pilot Wheel Feed



G. Wood Lathe

___a. Tailstock Locking Clamp

___b. Bed

___c. Switch

___d. Hand Wheel

___e. Spindle Lock

___f. Spindle

___g. Calibrated Tool Support

___h. Speed Control Hand Wheel

___i. Steel Cabinet

___j. Head Stock

___k. Tool Support Base

___l. Variable Speed Dial

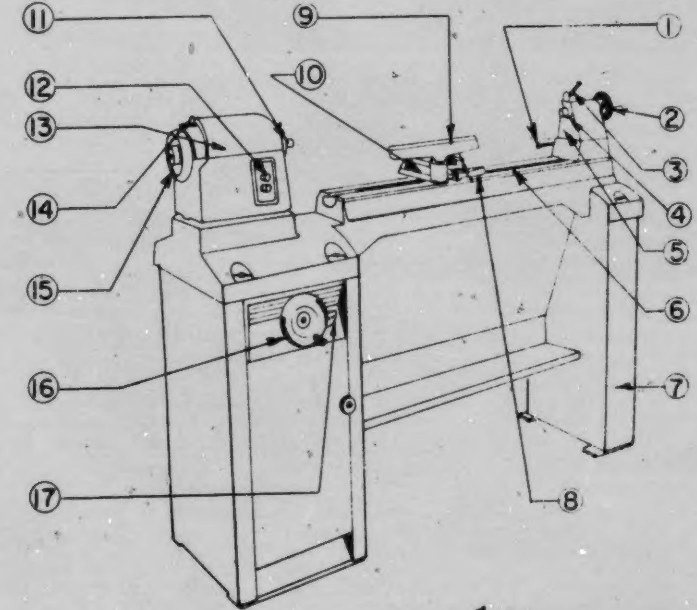
___m. Locking Handle For Tool Support Base

___n. Tailstock

___o. Indexing Pin

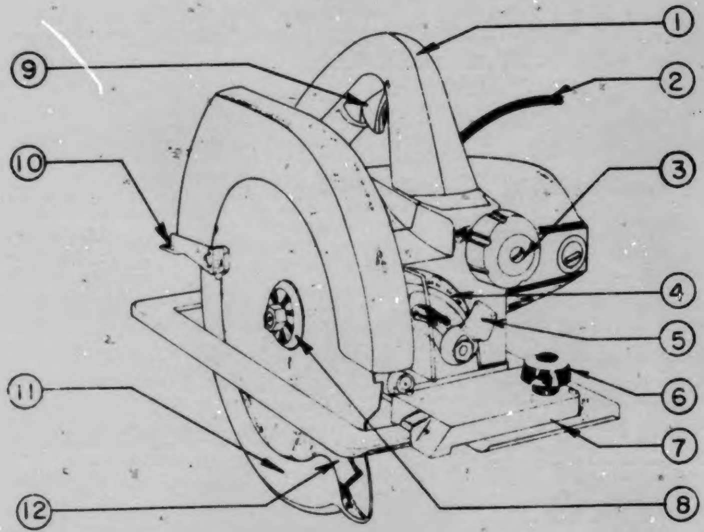
___p. Head Stock Spindle

___q. Hand Wheel



H. Electric Hand Saw

___a. Handle
___b. Angle Scale
___c. Trigger Switch
___d. Blade
___e. Tilting Base
___f. Power Cord
___g. Guide Knob
___h. Guard Lift Handle
___i. Retractable
___j. Anti-Kick Back Clutch
___k. Tilt Lock Knob
___l. Rip Guide Lock Knob



I. Sabre Saw

___a. Handle

___b. Brushes

___c. On-Off Switch

___d. Toe

___e. Guide Knob

___f. Tilting Base

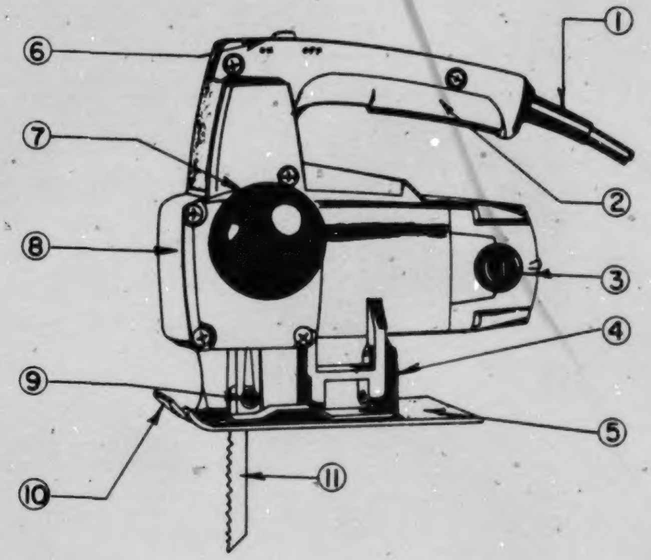
___g. Blade

___h. Aluminum Housing

___i. Blade Screw

___j. Cord Strain Reliever

___k. Base Tile Adjustment



J. Belt Sander

___a. Trigger Switch

___b. Belt

___c. Front Handle

___d. Dust Bag

___e. Switch Lock

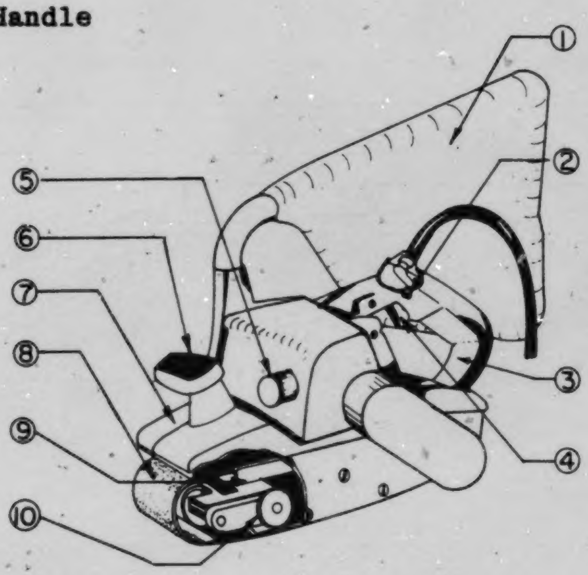
___f. Brush Holder

___g. Aluminum Housing

___h. Belt Striker Bar

___i. Belt Tracking Adjustment

___j. D-Handle



K. Electric Hand Drill

___a. Reversing Switch

___b. Aluminum Housing

___c. Cord Strain Reliever

___d. Pistol Grip Handle

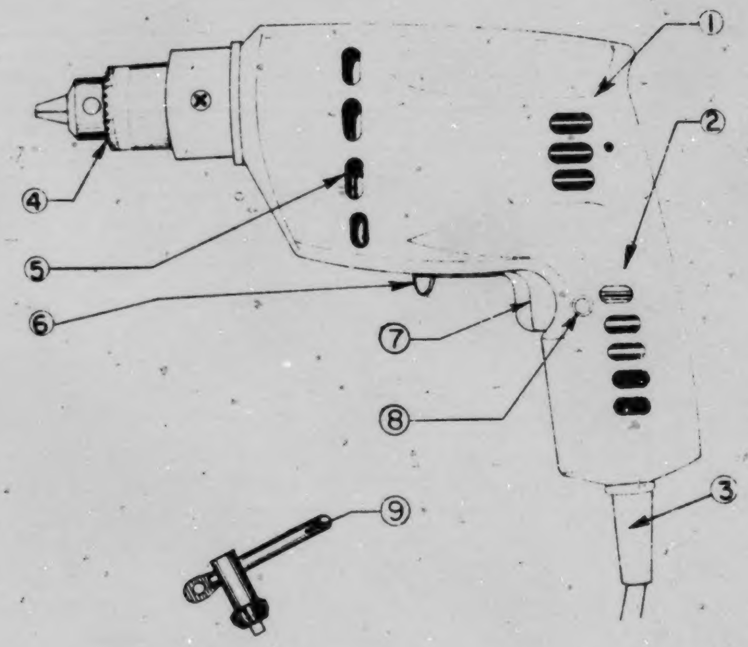
___e. Switch Lock

___f. Chuck Wrench

___g. Cooling Vents

___h. Geared Key Chuck

___i. Trigger Switch



L. **Vibrator Sander**

___a. Brush Holder

___b. Insulated Trigger Switch

___c. Pad

___d. Paper Clamp

___e. Front Hand Knob

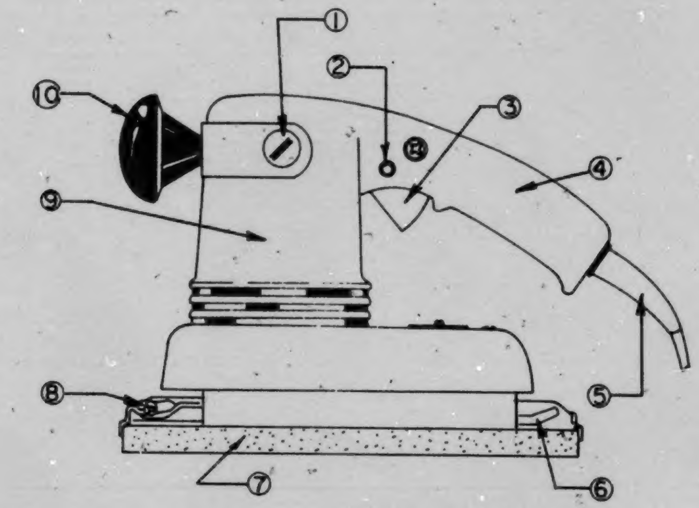
___f. Contoured Handle

___g. Switch Lock

___h. Aluminum Housing

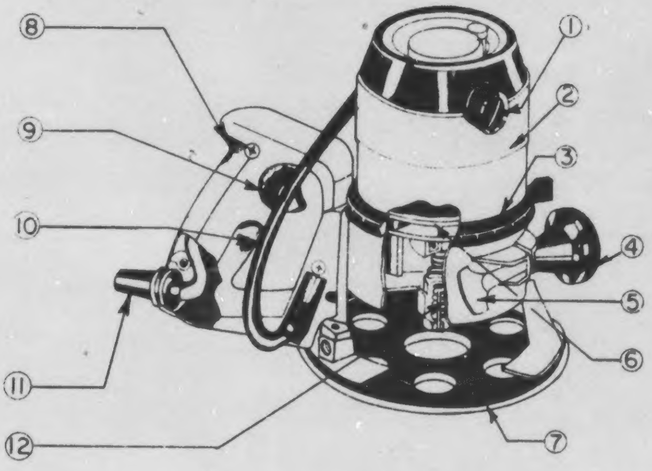
___i. Paper Clamps

___j. Cord Strain Reliever



M. Router

___a. Cord Strain Reliever
___b. D-Handle
___c. Guide Knob
___d. Motor Cooling Fan
___e. Brushes
___f. Motor Safety Disconnect
___g. Insulated Trigger Switch
___h. Sub-Base
___i. Aluminum Housing
___j. Locking Handle
___k. Micrometer Depth Adjustment
___l. Collet Type Chuck



POWER TOOLS

ANSWERS TO TEST

I\. A. 3
B. 9
C. 11
D. 4
E. 2
F. 5
G. 12
H. 1
I. 13
J. 8
K. 10
L. 6
M. 7

II\. A. P
B. S
C. S
D. P
E. S
F. P
G. S
H. P
I. P
J. S
K. P
L. S
M. S

III\. A. 4,3,1,2,5
B. 5,1,3,4,6,7
C. 8,12,3
D. 13,2,9,7,10,11
E. 10,14
F. 15,20,18,21
G. 19,17
H. 3,4,2,5
I. 4,3,8,16
J. 22,25
K. 15,23
L. 22,25
M. 26,24,27,20,7,18

IV. A. Table Saw or Bench Saw

a. 4
b. 11
c. 15
d. 2
e. 8
f. 14
g. 3
h. 1
i. 5
j. 7
k. 12
l. 9
m. 13
n. 10
o. 6

B. Radial Arm Saw

a. 4
b. 5
c. 10
d. 12
e. 2
f. 7
g. 11
h. 13
i. 3
j. 14
k. 1
l. 9
m. 6
n. 15
o. 8

C. Band Saw

a. 8
b. 9
c. 7
d. 14
e. 3
f. 13
g. 2
h. 11
i. 1
j. 4
k. 10
l. 16
m. 5
n. 15
o. 6
p. 12

D. Jointer

a. 9
b. 5
c. 2
d. 8
e. 3
f. 7
g. 1
h. 4
i. 6
j. 10

E. Surface Planner

a. 8
b. 5
c. 11
d. 2
e. 4
f. 10
g. 6
h. 1
i. 9
j. 7
k. 3
l. 12

F. Drill Press

a. 5
b. 9
c. 4
d. 1
e. 8
f. 13
g. 10
h. 2
i. 6
j. 7
k. 11
l. 14
m. 12
n. 3

G. Wood Lathe

a. 1
b. 6
c. 12
d. 2
e. 3
f. 4
g. 9
h. 16
i. 7
j. 13
k. 10
l. 17
m. 8
n. 5
o. 14
p. 11
q. 15

H. Electric Hand Saw

a. 1
b. 4
c. 9
d. 12
e. 7
f. 2
g. 3
h. 10
i. 11
j. 8
k. 5
l. 6

I. Sabre Saw

a. 2
b. 3
c. 6
d. 10
e. 7
f. 5
g. 11
h. 8
i. 9
j. 1
k. 4

J. Belt Sander

a. 4
b. 8
c. 6
d. 1
e. 2
f. 5
g. 7
h. 9
i. 10
j. 3

K. Electric Hand Drill

a. 6
b. 1
c. 3
d. 2
e. 8
f. 9
g. 5
h. 4
i. 7

L. Vibrator Sander

a. 1
b. 3
c. 7
d. 6
e. 10
f. 4
g. 2
h. 9
i. 8
j. 5

M. Router

a. 11
b. 8
c. 4
d. 6
e. 1
f. 10
g. 9
h. 7
i. 2
j. 5
k. 3
l. 12

SECTION D

UNIT I

CARPENTRY

CARPENTRY

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to match terms associated with carpentry to the correct definition, construct a box sill, layout and install the floor joist, layout and build walls and partitions and figure pitch and cut common rafters. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

I. Match terms associated with the carpentry trade to the correct definition.

II. List eight framing members that make up the floor and sill.

III. Define the purpose of a termite shield.

IV. Define the purpose of bridging.

V. List two types of subflooring.

VI. Compute the length of the regular stud.

VII. Identify seven roof styles.

VIII. Compute the length of a common rafter using the length of common rafter method.

IX. Demonstrate the ability to:

   A. Lay the sill and install the floor joist on 16" centers.

   B. Put plyboard flooring on the floor joist.

   C. Build "T"s and corners in conjunction with laying out and assembling outside walls and partitions on 16" centers.

   D. Layout, cut and install ceiling joist on 16" centers.

   E. Layout, cut and erect rafters on 16" centers.

CARPENTRY

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and job sheets.

   F. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheets.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1 - Floor and Sill Members

      2. TM 2 - Roof Styles

      3. TM 3 - Finding The Length of Common Rafters By The Length of Common Rafter Method

      4. TM 4 - Termite Shield

5. TM 5 - Sub-flooring
6. TM 6 - Wall and Partition Framing Members
7. TM 7 - Corners
8. TM 8 - Cutting Birds Mouth and Plumb Cut

D. Job sheet

1. Job sheet #1 - Lay The Sill and Install The Floor Joist On 16" Center
2. Job sheet #2 - Laying Plyboard On Floor Joist
3. Job sheet #3 - Building The Outside Walls
4. Job sheet #4 - Layout, Cut And Install Ceiling Joist On 16" Centers
5. Job sheet #5 - Layout, Cut and Erect Rafters On 16" Centers

E. Test

F. Answers to test

II. References:

A. Structures and Environment Handbook, Midwest Plan Service, 1975.

B. Wagner, Willis H., Modern Carpentry, The Goodheart Wilcox Co., Inc., 1973.

C. Wakeman, T.J. and McCoy, Vernon Lee, The Farm Shop, The Macmillan Co., 1960.

D. Residential Carpentry, Stillwater, Oklahoma, State Department of Vocational and Technical Education, 1973.

CARPENTRY

INFORMATION SHEET

I. Terms and definitions:

A. BRIDGING - Pieces fitted in pairs from the bottom of one floor joist to the top of adjacent joists and crossed to distribute the floor load.

B. JOIST HEADER - The framing member into which the common joists are fitted forming the box sill.

C. SILL - The lowest member of the frame of a structure, usually horizontal, resting on the foundation and supporting the floor joist and the uprights of the frame.

D. TERMITE SHIELD - A shield, usually made of sheet metal, placed in or on a foundation wall or around pipes to prevent the passage of termites into the structure.

E. DOUBLE PLATE - The top most member of a wall section attached to the top of the studs for the purpose of stiffening the wall and for tying together splices, corners and partitions that are at right angles to the wall.

F. HEADER - Horizontal structural member that supports the load over an opening such as a window or door. Also called a lintel.

G. PARTITION - A wall that subdivides space within any story of a building.

H. ROUGH OPENING - The opening formed by the framing members.

I. GIRDER - A large or principal beam used to support concentrated loads at particular points along its length.

J. SOLE PLATE - The lowest horizontal member on a wall or partition which rest on the rough floor to which the studding is nailed.

K. STUD - One of a series of vertical wood structural members in walls and partitions.

L. BARGE RAFTER - An exposed rafter at the end of a gable roof.

INFORMATION SHEET

M. BIRDS MOUTH - A notch cut out of a rafter which fits over the double plate.

N. COMMON RAFTER - One of several rafters extending from the double plate to the ridge board.

O. PITCH - Slope of a roof.

P. PLUMB CUT - The cut at right angles to the seat of the birds mouth and is also the cut of the rafter at the ridge.

Q. RIDGE BOARD - The highest horizontal board on a gable roof to which the upper end of the rafters are nailed.

R. RISE - The incline or pitch of a roof expressed in terms of inches per one foot of run.

S. RUN - The horizontal distance that under lies the slope of the roof from a wall to the ridge, usually one-half of the span.

T. SEAT CUT - The cut at the lower end of a rafter; the part of the birds mouth that rests on the plate.

II. Eight framing members that make up the floor and sill.

A. Sill Sealer

B. Termite Shield

C. Sill

D. Joists

E. Joist Header

F. Beam or Girder

G. Bridging

H. Subfloor

III. Purpose of a termite shield. TM 4

A. Prevents the passage of termites to the wooden structure.

IV. Purpose of bridging.

A. Helps distribute the stress or load.

INFORMATION SHEET

V. Types of subflooring. TM 5

A. Lumber - Normally running diagonally across the floor.

B. Plyboard - Splices are normally staggered for added strength.

VI. Computing the length of a regular stud.

A. Step 1 - If blueprints are used, check stated ceiling height.

B. Step 2 - Determine the thickness of the sole plate plus the double top plate.

C. Step 3 - Determine the thickness of the flooring and ceiling material.

D. Step 4 - Add the thickness of the ceiling and flooring material to the sum of step 2 and subtract from desired ceiling height.

EXAMPLE:-

Assume:

Sole Plate = 1 5/8" thick

Double Top Plate = 1 5/8" X 2" thick

Carpet = ¼" thick

Celotex = ½" thick

Step 1 = Blueprint states that ceiling is 8' with celotex in place.

Step 2 - Sole Plate = 1 5/8"

Double Plate = 3¼"

Carpet = ¼"

Celotex = ½"

---

5 5/8"

Length of regular stud = 8' 0" - 5 5/8"

7' 11 8/8" - 5 5/8" = 7' 6 3/8"

INFORMATION SHEET

VII. Identify seven roof styles. TM 2

A. Gable

B. Hip

C. Shed

D. Flat

E. Gable and Dormer

F. Mansard

G. Gambrel

VIII. Find length of common rafter using the length of common rafter method. TM 3

NOTE: This is only one of several ways to find the length of common rafters.

Example:

Assume: 26' wide building

Find: Total rise and length of a common rafter

Step 1 - Find unit rise

If ¼ pitch is given:

Unit rise = pitch X 24 (for any span)

= ¼ X 24 = 6" / Ft. of run

If 6/12 slope is given:

(6/12 means 6" rise per 12" run)

Unit Rise = 6"/Ft. of run

Step 2 - Find unit length

$$\text{Unit Length} = \sqrt{(\text{unit rise})^2 + (12")^2}$$

$$= \sqrt{6^2 + 12^2}$$

$$= \sqrt{36 + 144}$$

$$= \sqrt{180}$$

= 13.42"/Ft. of run

INFORMATION SHEET

Step 3 - Rise = Unit rise X Run

= 6"/Ft. X 13'

= 6½'

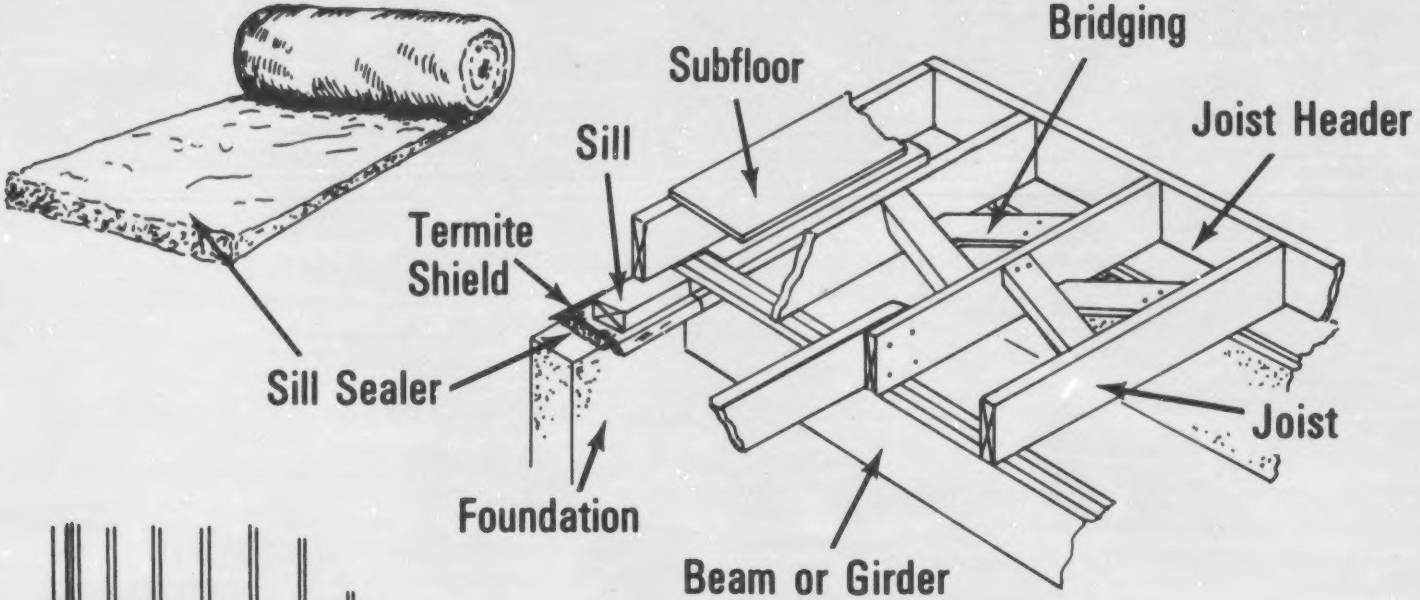
Step 4 - LCR = Unit Length X Run

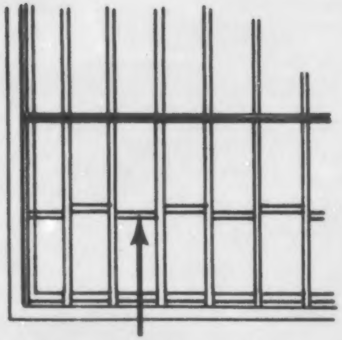
= 13.42"/Ft. X 13'

= 14' - 6 7/16"

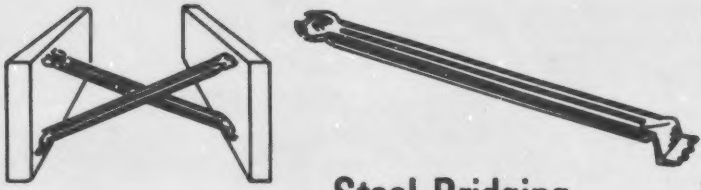
NOTE: This total length only goes to the plumb cut of the birds mouth, if any overhang is desired, it must be added on to the total length.

Floor and Sill Members


Bridging
Subfloor
Joist Header
Sill
Termite Shield
Sill Sealer
Joist
Foundation
Beam or Girder

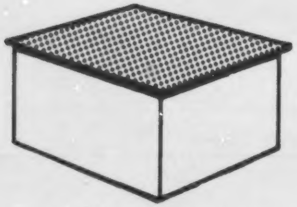


Solid Bridging

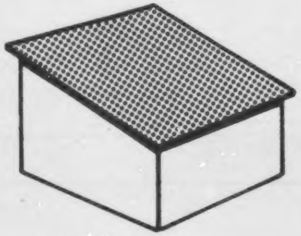


Steel Bridging

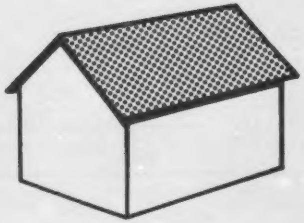
Roof Styles



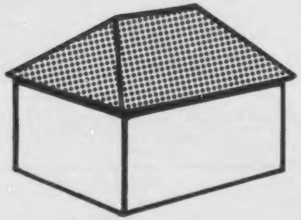
Flat Roof



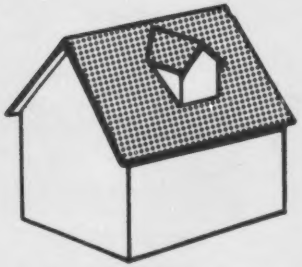
Shed or
Lean-To Roof



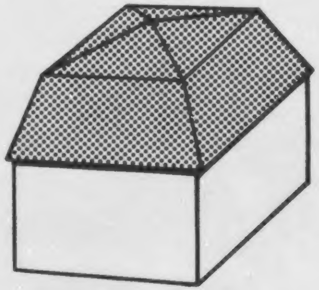
Gable Roof



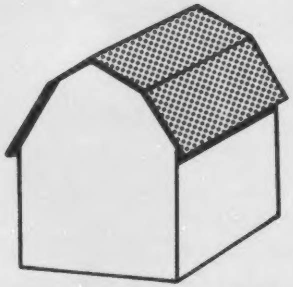
Hip Roof



Gable Roof
and Dormer

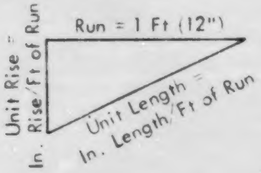


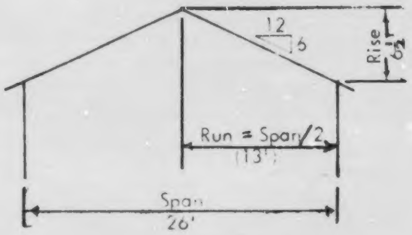
Mansard Roof



Gambrel Roof

FINDING THE LENGTH OF COMMON RAFTER
BY THE LENGTH OF COMMON RAFTER METHOD (LCR)


Run = 1 Ft (12")
Unit Rise = In. Rise/Ft of Run
Unit Length = In. Length/Ft of Run


12
6
Rise 6½'
Run = Span/2 (13')
Span 26'

ASSUME: 26' Wide Building
FIND: Total Rise and Length of a Common Rafter

1. Find Unit Rise

If $\frac{1}{4}$ Pitch is Given:
Unit Rise = Pitch x 24 (for any span)
= $\frac{1}{4}$ x 24 = 6"/Ft of Run

If 6/12 Slope is Given:
(6/12 means 6" Rise per 12" Run)
Unit Rise = 6"/Ft of Run

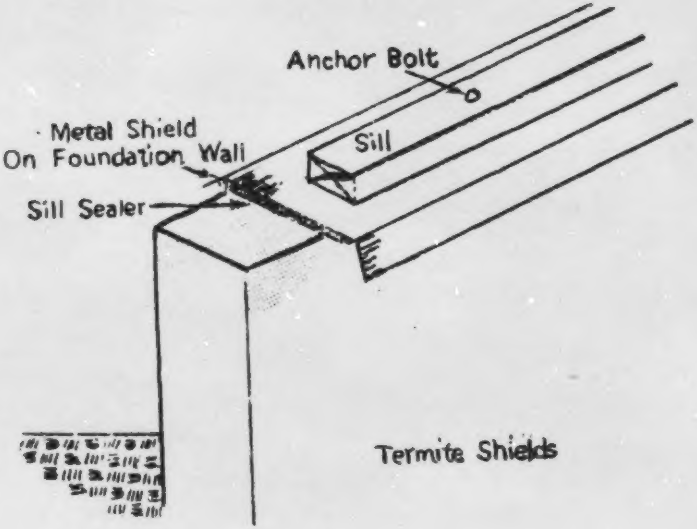
2. Find Unit Length

$$\text{Unit Length} = \sqrt{(\text{Unit Rise})^2 + (12'')^2} = \sqrt{6^2 + 12^2} = \sqrt{36 + 144} = \sqrt{180} = 13.42''/\text{Ft of Run}$$

3. Rise = Unit Rise x Run
= 6"/Ft x 13' - 6½'

4. LCR = Unit Length x Run
= 13.42"/Ft x 13' = 14'-6 7/16"

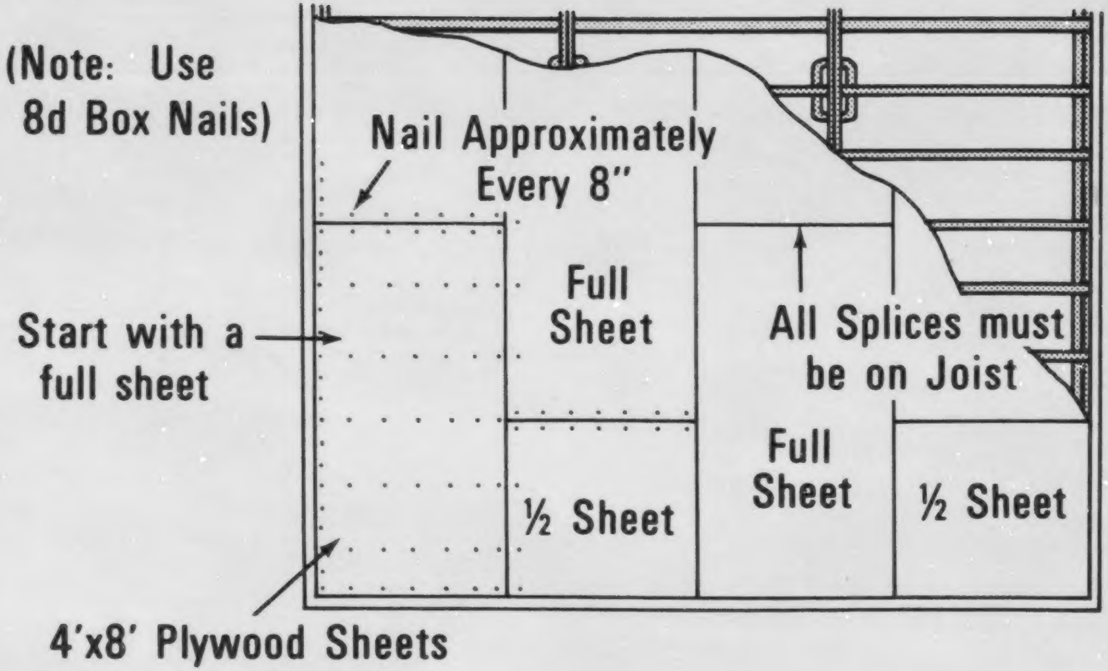
Termite Shield


Anchor Bolt
Metal Shield
On Foundation Wall
Sill Sealer
Sill

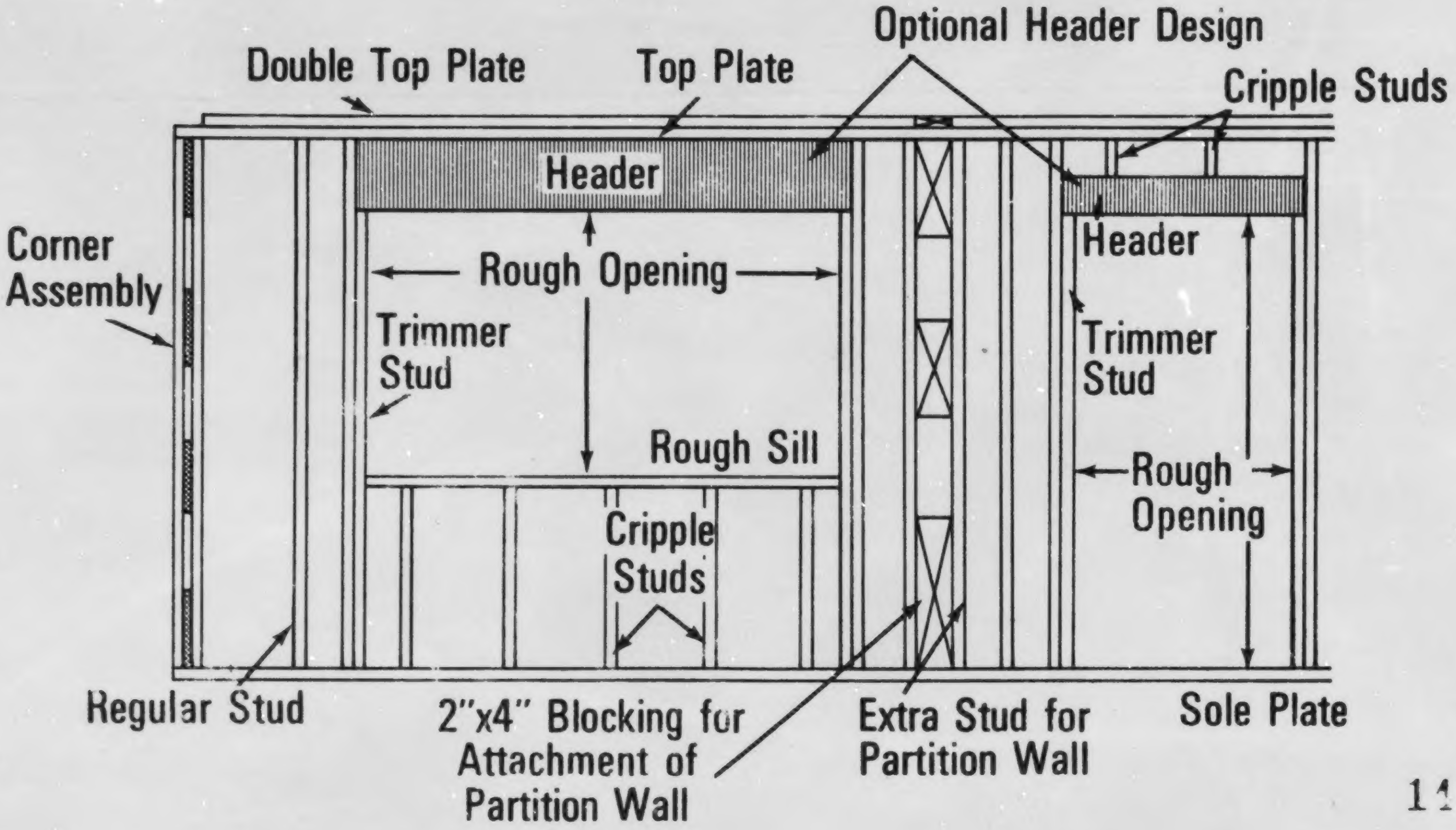
Termite Shields

Subflooring

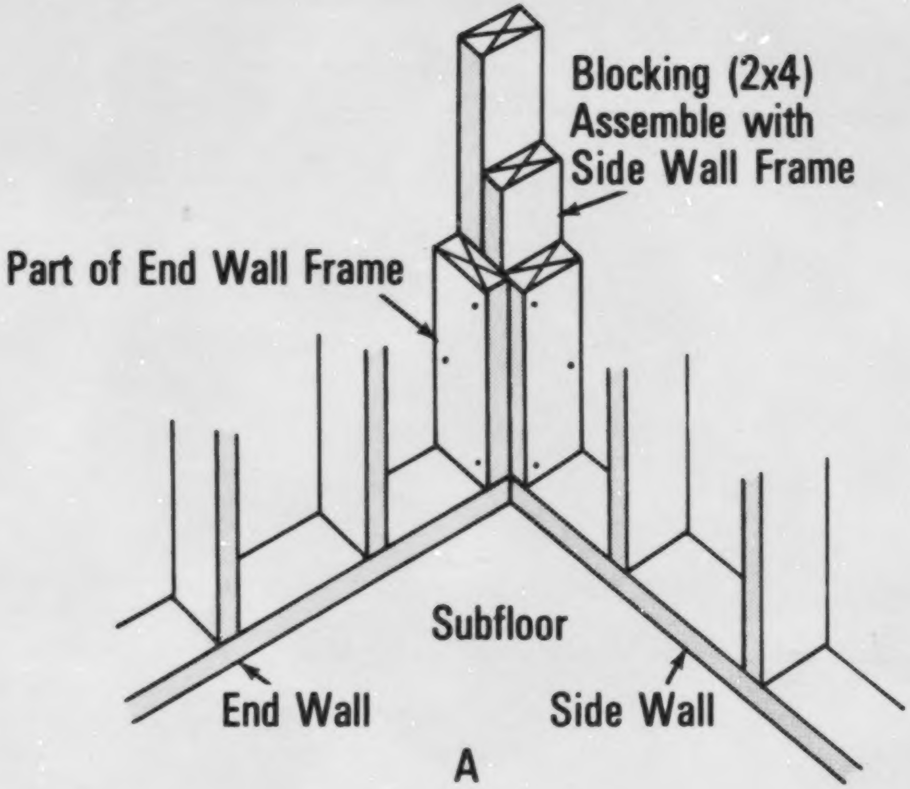
4'x8' Plywood

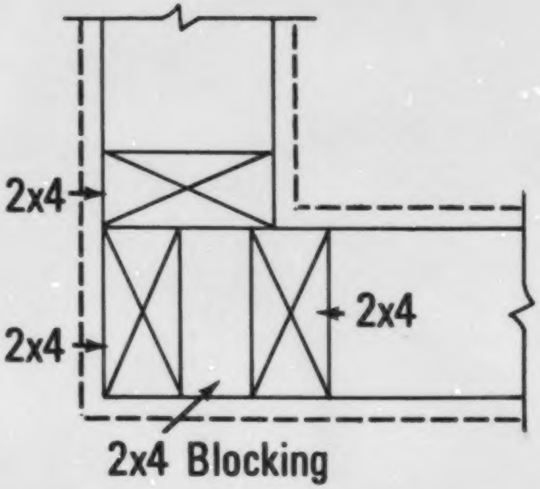

(Note: Use
8d Box Nails)
Nail Approximately
Every 8"
Full
Sheet
All Splices must
be on Joist
Start with a
full sheet
Full
Sheet
½ Sheet
½ Sheet
4'x8' Plywood Sheets

Wall and Partition Framing Members

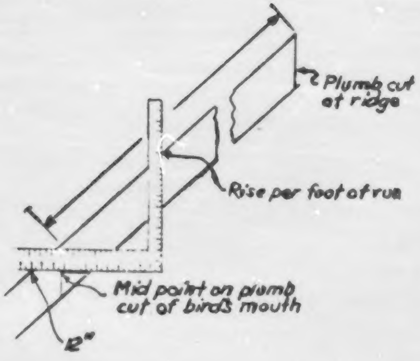

Optional Header Design
Double Top Plate
Top Plate
Cripple Studs
Header
Corner Assembly
Rough Opening
Header
Trimmer Stud
Trimmer Stud
Rough Sill
Rough Opening
Cripple Studs
Regular Stud
2"x4" Blocking for Attachment of Partition Wall
Extra Stud for Partition Wall
Sole Plate

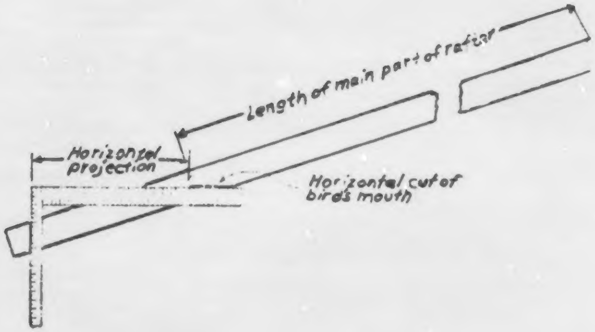
Corners

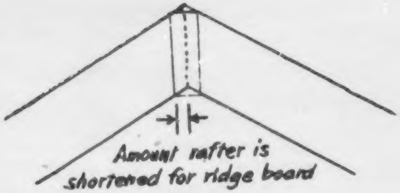

Blocking (2x4)
Assemble with
Side Wall Frame
Part of End Wall Frame
Subfloor
End Wall
Side Wall
A


2x4
2x4
2x4
2x4 Blocking

Cutting Birds Mouth and Plumb Cut


Plumb cut at ridge
Rise per foot of run
Mid point on plumb cut of birds mouth
12"


Length of main part of rafter
Horizontal projection
Horizontal cut of birds mouth


Amount rafter is shortened for ridge board

CARPENTRY

JOB SHEET #1 - LAYING SILL AND INSTALLING FLOOR JOISTS ON 16" CENTERS

NOTE: This will be a utility building measuring 16' in length by 14' in width.

I. Tools and materials needed.

A. Tools

1. Framing square
2. Electric Handsaw
3. Carpenters Pencil
4. Tin Snips
5. Claw Hammer
6. Level
7. 20 foot tape measure
8. Electric Hand Drill
9. 5/8" Speed Bit
10. Sabre Saw
11. 14" Adjustable Wrench
12. 2 Saw Horses

B. Materials

1. Sill Sealer
2. Termite Shield
3. Girder Material
4. 2" X 6" for Sills
5. 2" X 8" for Joist Headers
6. 16d common Nails for Joist and Headers
7. 7/8" CD Plyboard for flooring
8. 8d box nails

II. Procedure:

NOTE: Assume footings and foundation are in place with anchor bolts intact.

A. Step 1 - Square and cut the sills to length and drill the holes for the anchor bolts.

B. Step 2 - Apply sill sealer and termite shield to foundation cutting out for anchor bolts. Refer to TM 4.

C. Step 3 - Put pre-cut sills in place and bind them down with the anchor bolts after squaring them with framing square.

D. NOTE: The holes drilled in the sills should be larger than the anchor bolts in order to square them before securing the sills with the anchor bolts.

D. Step 4 - Attach a joist header on both ends to form a box sill using 16d common nails, 5 every 10".

E. Step 5 - Center and level a beam underneath and flush it up with the sill. The beam will run with the length of the building so as to form 90° angles to the floor joists.

F. Step 6 - Using the 20 foot tape, stretch it out on the width side and mark 16 centers. This should be done on both sides to insure squareness.

G. Step 7 - Put two 16d common nails through the joist header into each joist.

CARPENTRY

JOB SHEET #2 - LAYING PLYBOARD ON FLOOR JOIST

I. Tools and materials needed:

- A. Tools
    - 1. Electric hand saw
    - 2. 20 foot tape measure
    - 3. Framing square
    - 4. Carpenters pencil
    - 5. Claw hammer
    - 6. Chalk line
    - 7. 2 saw horses
- B. Materials
    - 1. 7/8" CD plyboard
    - 2. 8d box nails

II. Procedure:

- A. Step 1 - Lay a sheet of plyboard on a corner and square it with the outside edge.
- B. Step 2 - Nail perimeter every 6" and the other joist every 8". TM 5
- C. Step 3 - Stagger the splices on a ½ sheet base as much as possible for added strength.

CARPENTRY

JOB SHEET #3 - BUILDING OUTSIDE WALLS

Note: There will be no partition walls therefore there will be no "T's" on the outside wall.

I. Tools and materials needed:

A. Tools

1. Framing square
2. Electric handsaw
3. Carpenters pencil
4. 2 saw horses
5. Claw hammer
6. 20 foot tape measure

B. Materials

1. 2 X 4's sufficient to do four walls
2. 16d common nails
3. Header for door

II. Procedure:

A. Step 1- Square both ends of sole and top plate and lay side by side on the floor. (Note: Both plates need to run the entire length of the building.)

B. Step 2 - Use measuring tape and mark off 16" centers on both plates. There will be a door measuring 3'-0" X 6'-8" that needs a rough opening of 3' 2 3/4". This extra space will provide for the door and side jams plus the clearance it needs. The header will measure 41 3/8" long and 6 5/8" wide.

NOTE: Rough opening for the door can be made in any part of the wall.

C. Step 3 - Cut studs needed for wall plus 4 extra for corners 7' 6 3/8" long. This will assume and 8' ceiling. Note: Build corners as pictured on TM 6.

D. Step 4 - After sole and top plates have been marked for stud placement and studs have been cut, layout wall and nail together with each stud receiving 2, 16d common nails at both plates.

E. Step 5 - After assembling wall, have bracing material and level ready. Raise the wall into position and square or flush up sole plate to the perimeter and nail the sole plate down.

F. Step 6 - Have brace nailed to the upper portion of the wall when wall is erected. After sole plate is nailed, plumb wall with level and nail the lower end of the brace to the joist or joist header. (Note: The other walls will go up basically the same except for the corners. Refer to TM 6.)

CARPENTRY

JOB SHEET #4 - LAYOUT, CUT AND INSTALL CEILING JOIST ON 16 INCH CENTERS

I. Tools and materials needed:

A. Tools

1. Framing square
2. 2 saw horses
3. Electric handsaw
4. Claw hammer
5. Carpenters pencil
6. 20 foot tape measure

B. Materials

1. 2 X 4's sufficient for ceiling joists
2. 16d common nails

II. Procedure:

A. Step 1 - Nail the double plate on both 14 foot walls allowing 16" overhand on each end.

B. Step 2 - Stretch 20 foot tape along the plate and mark the 16 foot intervals. The same procedure should be done on both plates to allow for squareness of the ceiling joists.

C. Step 3 - Square and cut the ceiling joist the proper length.

D. Step 4 - Toe nail the ceiling joist at the intervals marked on the double plate.

CARPENTRY

JOB SHEET #5 - LAYOUT, CUT AND ERECT RAFTERS ON 16 INCH CENTERS

I. Tools and materials needed:

  A. Tools

    1. Framing square
    2. 2 saw horses
    3. Electric handsaw
    4. Crosscut handsaw
    5. Claw hammer
    6. Carpenters pencil
    7. 20 foot tape measure

  B. Materials

    1. 2 X 4's sufficient for rafters
    2. 16d common nails

II. Procedure:

  A. Step 1 - Figure the length of the common rafters by the LCR method. The pitch will be ¼. Refer to information sheet for correct procedure.

  B. Step 2 - When cutting birds mouth, refer to TM 8.

  C. Step 3 - After one rafter has been properly cut, use it as a pattern.

  D. Step 4 - Cut ridge board the same length as the double plate.

  E. Step 5 - Put ridge board against the double plate and mark the 16" intervals so as the rafters and ceiling joists will be side by side. This allows you to nail them together for added strength.

  F. Step 6 - With the aid of a helper, secure ridge board in position with some temporary bracing.

G. Step 7 - Erect rafters into position and nail at birds mouth and nail to ceiling joist.

H. Step 8 - It may be necessary to erect rafters on all corners to keep ridge board in the proper position. (Note: It will be necessary to cut off the corner of the ceiling joist so as the decking will fit correctly.)

AS - 37-D

CARPENTRY

TEST

I. Match the terms below to the correct definition.

___A. Bridging

___B. Joist Header

___C. Sill

___D. Seat Cut

___E. Run

___F. Rise

___G. Common Rafter

___H. Pitch

___I. Plumb Cut

___J. Ridge Board

___K. Termite Shield

___L. Birds Mouth

___M. Double Plate

___N. Barge Rafter

___O. Header

___P. Stud

___Q. Partition

___R. Sole Plate

___S. Rough Opening

___T. Girder

1. Pieces fitted in pairs from the bottom of one floor joist to the top of adjacent joists and crossed to distribute the floor load.

2. The framing member into which the common joists are fitted forming the box sill.

3. The lowest member of the frame of a structure, usually horizontal, resting on the foundation and supporting the floor joist and the uprights of the frame.

4. A shield, usually made of sheet metal, placed in or on a foundation wall or around pipes to prevent the passage of termites into the structure.

5. The top most member of a wall section attached to the top of the studs for the purpose of stiffening the wall and for tying together splices, corners and partitions that are at right angles to the wall.

6. Horizontal structural members that support the load over an opening such as a window or door. Also called a lintel.

7. A wall that subdivides space within any story of a building.

8. The opening formed by the framing members.

9. A large or principal beam used to support concentrated loads at particular points along its length.

10. The lowest horizontal member on a wall or partition which rest on the rough floor to which the studding is nailed.

11. One of a series of vertical wood structural members in walls and partitions.

12. An exposed rafter at the end of a gable roof.

13. A notch cut out of a rafter which fits over the double plate.

14. One of several rafters extending from the double plate to the ridge board.

15. Slope of a roof.

16. The cut as right angles to the seat out of the birds mouth and is also the cut of the rafter at the ridge.

17. The highest horizontal board on a gable roof to which the upper end of the rafters are nailed.

18. The incline or pitch of a roof expressed in terms of inches per one foot of run.

19. The horizontal distance that under lies the slope of the roof from a wall to the ridge, usually ½ of the span.

20. The cut at the lower end of a rafter; the part of the birds mouth that rests on the plate.

II. List eight framing members that make up the floor and sill.

A.
B.
C.
D.

E.
F.
G.
H.

III. Define the purpose of a termite shield.

IV. Define the purpose of bridging.

V. List two types of subflooring.

A.

B.

VI. Compute the length of the regular stud.

VII. Identify seven roof styles.

A.

B.

C.

D.

E.

F.

G.

VIII. Compute the length of a common rafter using the length of common rafter method.

CARPENTRY

ANSWERS TO TEST

I.

A.	1	K.	4
B.	2	L.	13
C.	3	M.	5
D.	20	N.	12
E.	19	O.	6
F.	18	P.	11
G.	14	Q.	7
H.	15	R.	10
I.	16	S.	8
J.	17	T.	9

II. A. Sill Sealer

B. Termite shield

C. Sill

D. Joists

E. Joist Header

F. Beam or Girder

G. Bridging

H. Subfloor

III. Prevents the passage of termites to the wooden structure.

IV. Helps distribute the stress or load.

V. A. Lumber

B. Plyboard

VI. To the satisfaction of the instructor.

VII. A. Gable
B. Hip
C. Shed
D. Flat
E. Gable and Dormer
F. Mansard
G. Gambrel

VIII. To the satisfaction of the instructor.

SECTION E

UNIT I

BLUEPRINT READING FOR STRUCTURES

BLUEPRINT READING FOR STRUCTURES

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to read blueprints with respect to the alphabet of lines, drawing symbols, scale and specifications. This knowledge will be evidenced by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with blueprint reading for structures to the correct definition.

II. List five types of architectural drawing.

III. List the types of lines included in the alphabet of lines.

IV. Identify architectural, plumbing, piping, ductwork, structural and electrical symbols.

V. List 12 scales on an architect scale.

VI. Extract specific information from a prepared set of building specifications.

BLUEPRINT READING FOR STRUCTURES

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheets.

   F. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheets

   C. Transparency masters

      1. TM 1 - Plot Plan

      2. TM 2 - Foundation Plan

      3. TM 3 - Floor Plan

      4. TM 4 - Elevations

      5. TM 5 - Details

      6. TM 6 - Alphabet of Lines

      7. TM 7 - Alphabet of Lines

8. TM 8 - Alphabet of Lines
9. TM 9 - Architectural Symbols
10. TM 10 - Plumbing and Piping Symbols
11. TM 11 - Ductwork and Structural Symbols
12. TM 12 - Electrical Symbols
13. TM 13 - Door Schedule
14. TM 14 - Window Schedule

D. Test

E. Answers to test

II. References:

A. Bellis, Herbert F. and Schmidt, Walter A., Blueprint Reading For The Construction Trades, New York, New York, McGraw Hill Book Co., 1968.

B. Hornung, William J., Architectural Drafting, Englewood Cliffs, New Jersey, Prentice Hall, 1971.

C. Blueprint Reading and Building Codes, Stillwater, Oklahoma, State Department of Vocational and Technical Education, 1973.

BLUEPRINT READING FOR STRUCTURES

INFORMATION SHEET

I. Terms and definitions:

A. ALPHABET OF LINES - Set of conventional symbols covering all the lines needed to depict an object as to size and shape.

B. ARCHITECTS SCALE - A scale or rule divided in several scales which have inch fractions equal to to a foot.

C. BLUEPRINT - A copy of the original detailed drawing.

D. DETAIL VIEW - A view of the product with dimensions and other pertinent information required to make the part.

E. ELEVATION VIEW - Are the front, rear and side views of a structure.

F. PLAN VIEW - Horizontal cut through a building showing the foundation, rooms, partitions, windows, doors and stairs.

G. SECTION VIEW - A drawing of an object which has been cut apart to show the interior construction or material.

H. SPECIFICATIONS - The written description that accompanies a set of drawing and describes the work to be performed.

I. SYMBOL - An arbitrary sign that has been standardized and is used to represent an object, quality or method.

J. WORKING DRAWING - A drawing or drawings that give the craftsman the necessary information to make and assemble a product.

II. Types of architectural drawings. TM 1,2,3,4 and 5.

A. Plot Plan - Characteristics include:

1. The location of the building on the lot.

2. Finished grade contours.

3. Property lines.

INFORMATION SHEET

4. Available utilities
5. Location of existing trees

B. Foundation Plan - Characteristics include:

1. The location of footings, stem walls and piers.
2. Openings and clearance for crawl space under a conventional wood floor.
3. Entrance for underground utilities and services.

C. Floor plan - Characteristics include:

1. Outside walls including the location and dimensions of all exterior openings.
2. The type of construction through the use of symbols.
3. The location of interior walls and partitions.
4. The way a door is to swing.
5. Stairways
6. The location of specific items such as dishwasher and other built ins.

D. Elevation

1. Characteristics
    a. Grade line
    b. Floor heights
    c. Head and sill heights of windows in each story
    d. Roof line and pitch
    e. Cornice
2. Typical elevations
    a. Front
    b. Left
    c. Right
    d. Rear

INFORMATION SHEET

e. Sectional

E. Details - Characteristics include:

NOTE: These drawings are primarily used to depict details of construction that are too small or not clearly shown on the plan or elevation drawings. They may be full size or to a larger scale that the plan, elevation or a sectional view.

1. Molding
2. Mill Work
3. Ornamental Iron
4. Cabinets
5. Fire Place
6. Built Ins
7. Stairs

III. Alphabet of lines. TM 6,7 and 8.

A. Object lines (————) - show the main outline of the building including exterior walls, interior partitions, porches, patios, driveways, and interior walls; these lines should be the outstanding lines on the drawing.

B. Dimension lines (←——→) - Thin unbroken lines which building dimensions are placed upon.

C. Extension lines (————) - Extend, but do not touch, the object lines and permit dimension lines to be drawn between them.

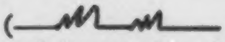
D. Hidden lines (------) - Short dashes used to show lines that are not visible from that view.

E. Center lines (-—-—-) - A series of short and long dashes used to designate the center of doors, windows, and circles and to provide a reference point for dimensioning.

F. Cutting Plane Lines (↑——--——--——↑) - Heavy lines consisting of a series of one long and two short dashes with arrows at each end pointing away from the area that is cut away for the purpose of sectioning.

INFORMATION SHEET

G. Section Lines (/////) - A series of lines of various shapes or symbols used to depict an area that is a cross section of the whole object and also depicts the type of material to be used in construction.

H. Break lines () - Used when an area cannot or should not be drawn entirely.

I. Leaders ( ) - Used to connect a note or dimension to a part of the building.

IV. Architectural, plumbing, piping, ductwork, structural and electrical symbols. Refer to TM 9,10,11,12 and 13.

V. The architects scale:

A. 12" = 1' - 0"

B. 6" = 1' = 0"

C. 3" = 1' - 0"

D. 1½" = 1' - 0"

E. 1" = 1' - 0"

F. 3/4" = 1' - 0"

G. ½" = 1' - 0"

H. 3/8" = 1' - 0"

I. ¼" = 1' - 0"

J. 3/16" = 1' - 0"

K. 1/8" = 1' - 0"

L. 3/32" = 1' - 0"

VI. Information from a prepared set of building specifications.

A. Specification - A detailed set of written instructions which explain the drawing and becomes part of the contract.

INFORMATION SHEET

B. Schedules. (TM 13 and 14) Schedules serve two basic purposes.

1. Conserve space on the drawing.
2. Includes all information needed to order materials or to do the job.

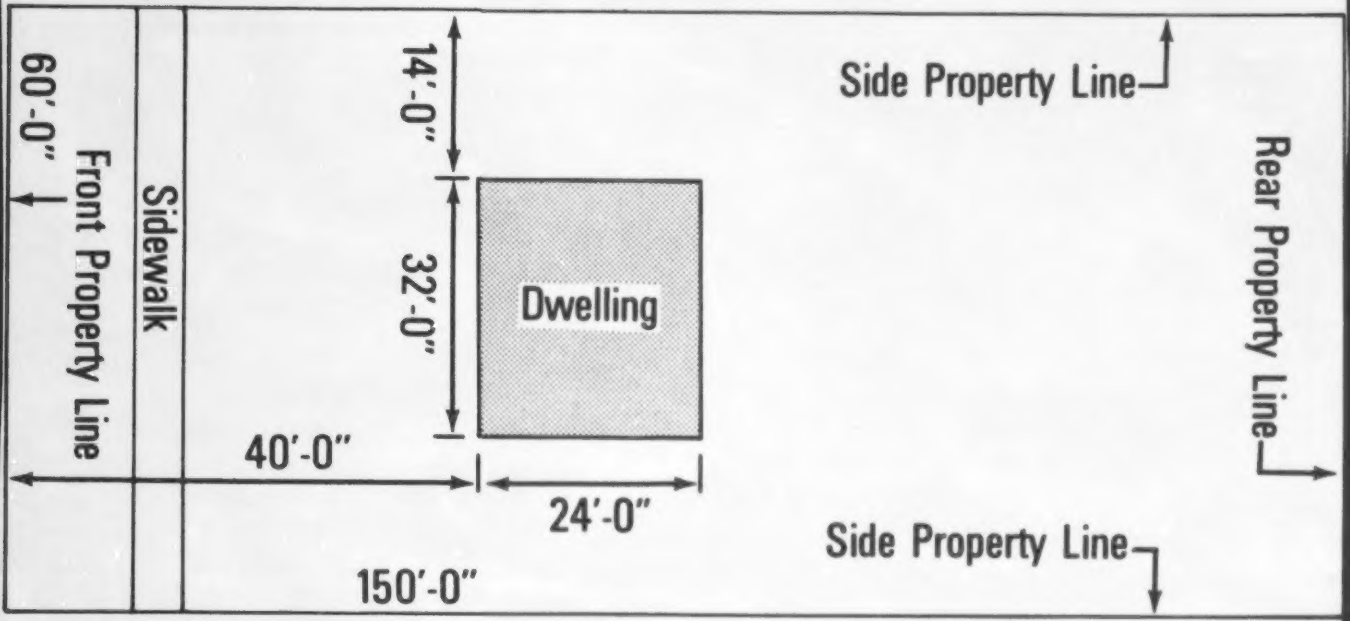
a. Door schedule information:

1. Width
2. Height
3. Thickness
4. Material
5. Type
6. Screen
7. Quantity
8. Threshold
9. Remarks
10. Manufacturer
11. Symbol

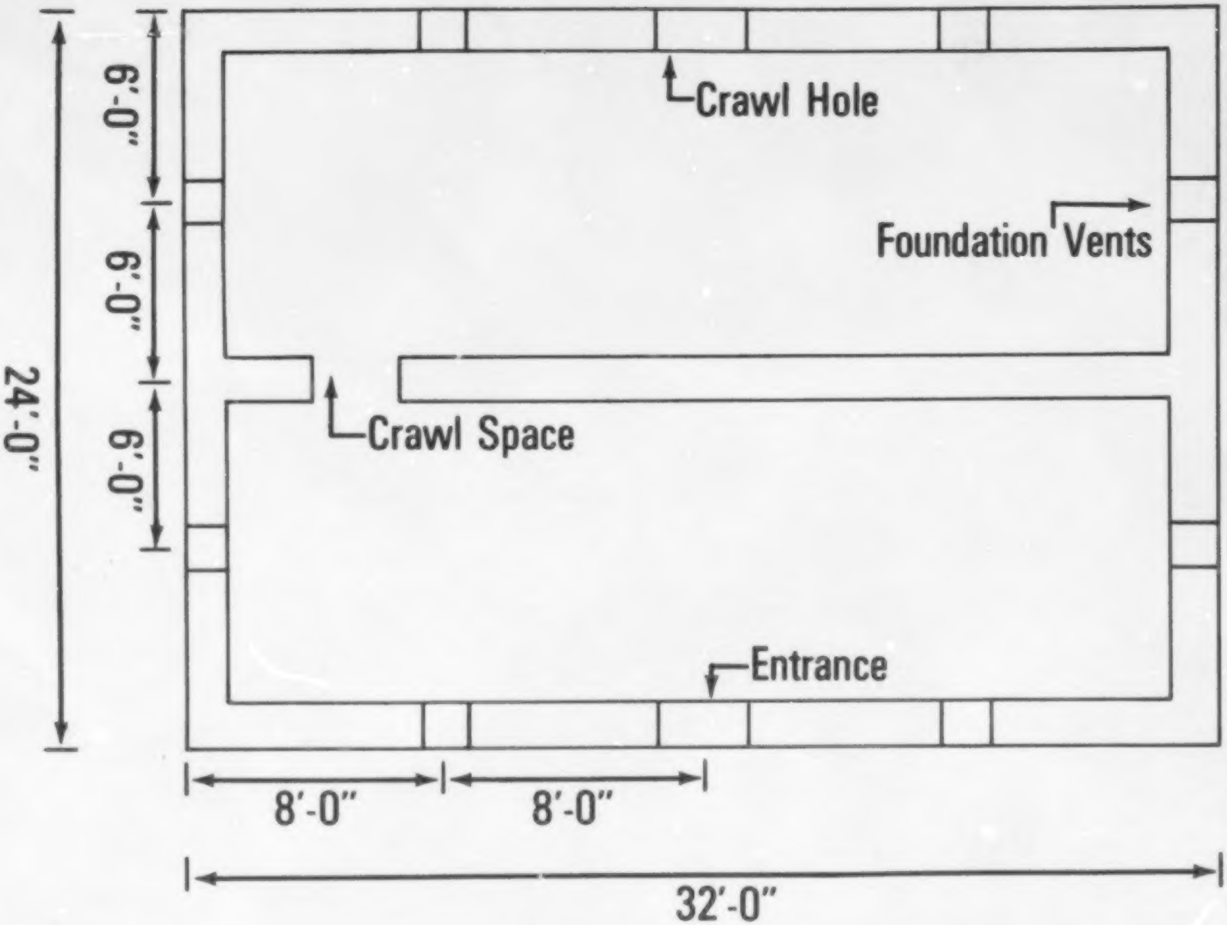
b. Window schedule information:

1. Width
2. Height
3. Material
4. Type
5. Screen
6. Quantity
7. Remarks
8. Manufacturer
9. Catalog number

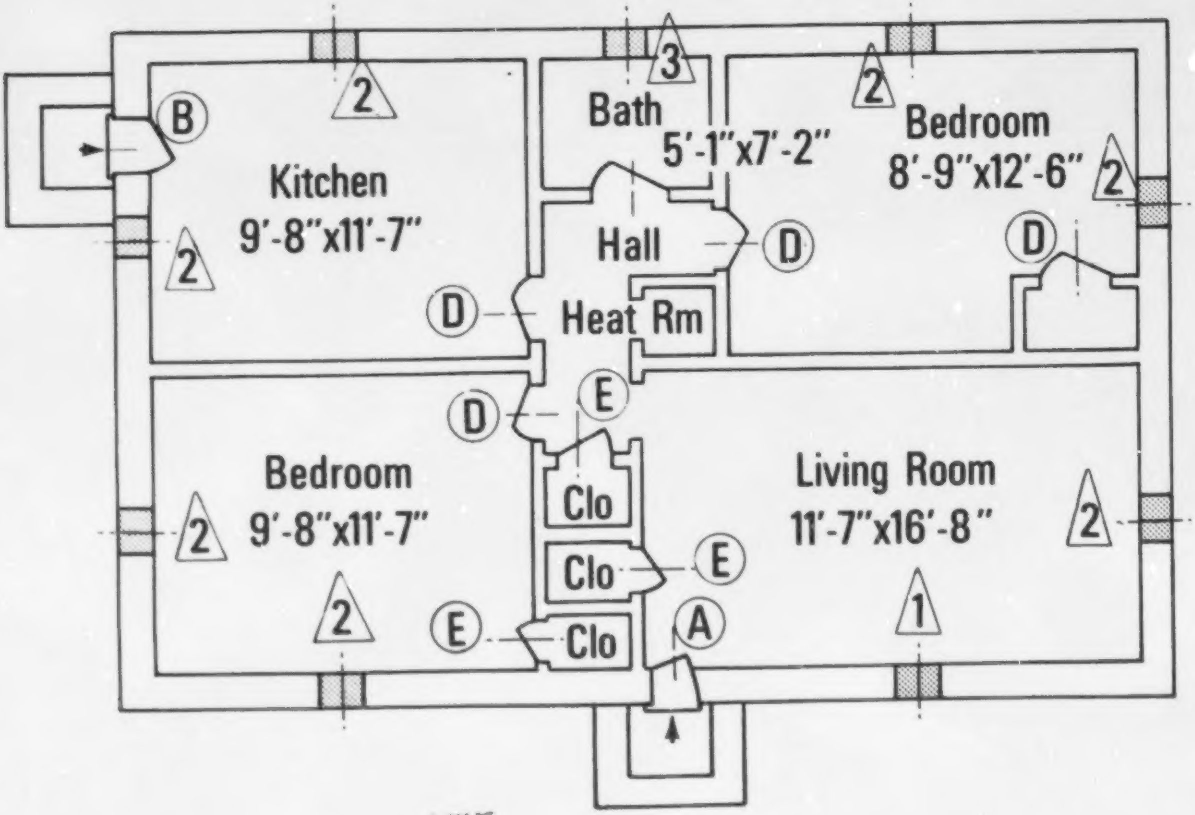
Plot Plan


Side Property Line
60'-0"
Front Property Line
Sidewalk
14'-0"
32'-0"
Dwelling
Rear Property Line
40'-0"
24'-0"
Side Property Line
150'-0"

Foundation Plan


Crawl Hole
Foundation Vents
Crawl Space
Entrance
6'-0"
6'-0"
6'-0"
24'-0"
8'-0"
8'-0"
32'-0"

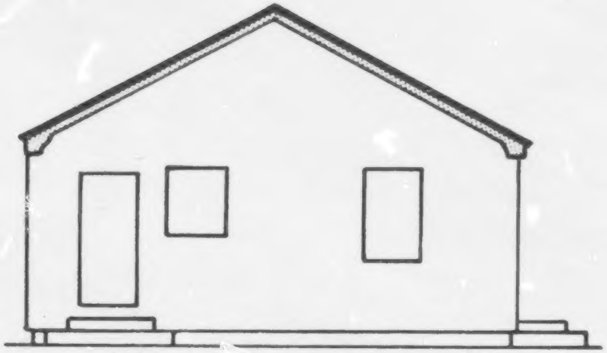
Floor Plan


Bath
5′-1″x7′-2″
Kitchen
9′-8″x11′-7″
Bedroom
8′-9″x12′-6″
Hall
Heat Rm
Bedroom
9′-8″x11′-7″
Living Room
11′-7″x16′-8″
Clo
Clo
Clo
A
B
D
D
D
D
E
E
E
1
2
3

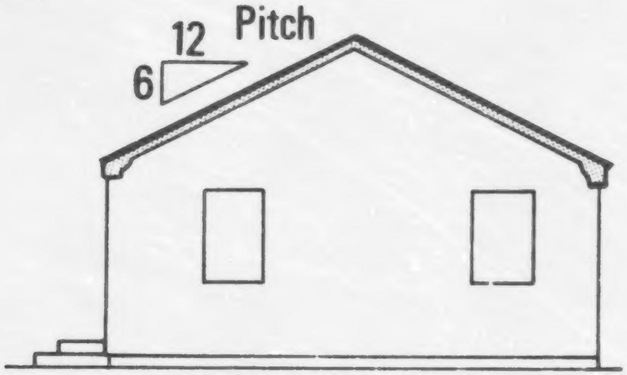
AS - 17-E

TM 4

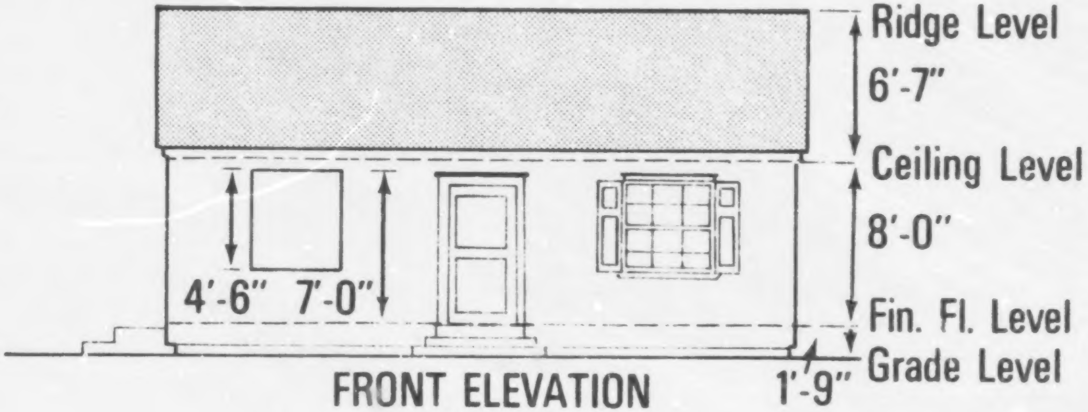
Elevations



LEFT SIDE ELEVATION



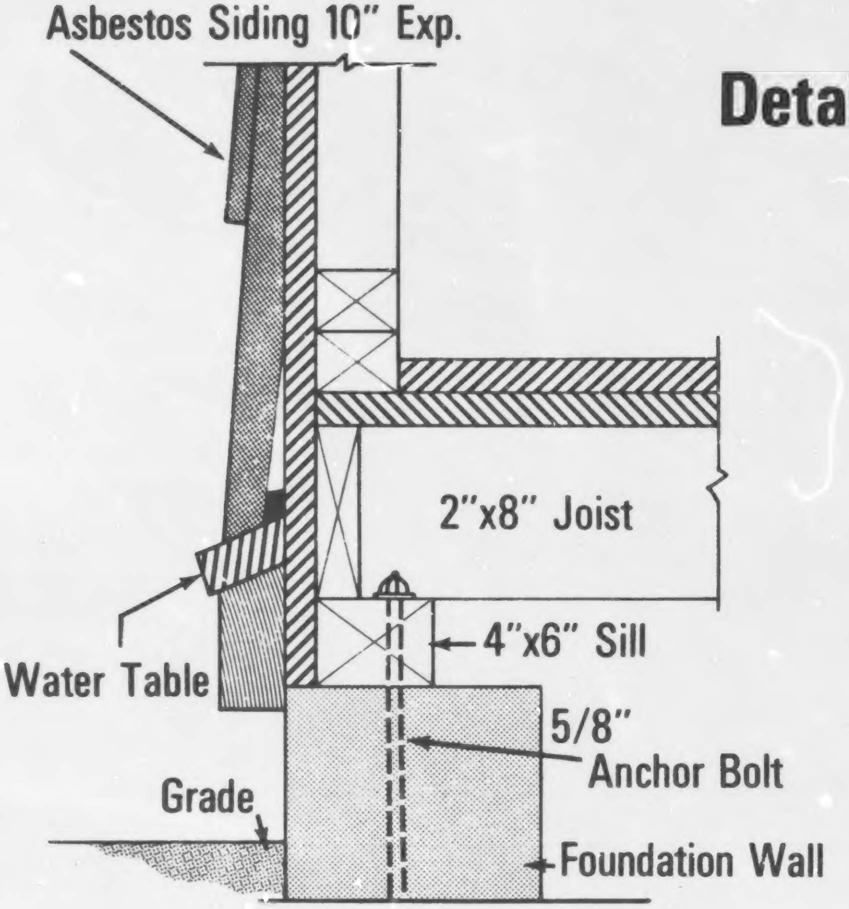
RIGHT SIDE ELEVATION


Ridge Level
6'-7"
Ceiling Level
8'-0"
Fin. Fl. Level
Grade Level
4'-6"
7'-0"
1'-9"

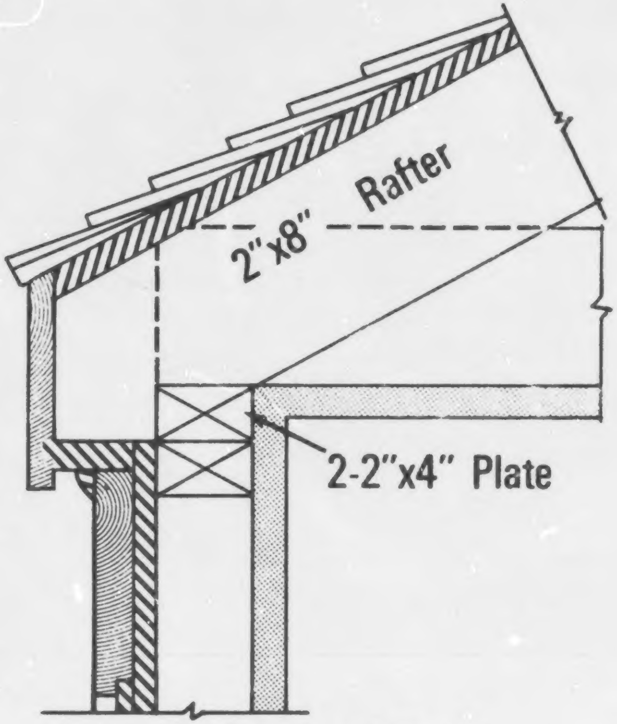
FRONT ELEVATION

Scale 1/8"=1'-0"

Details

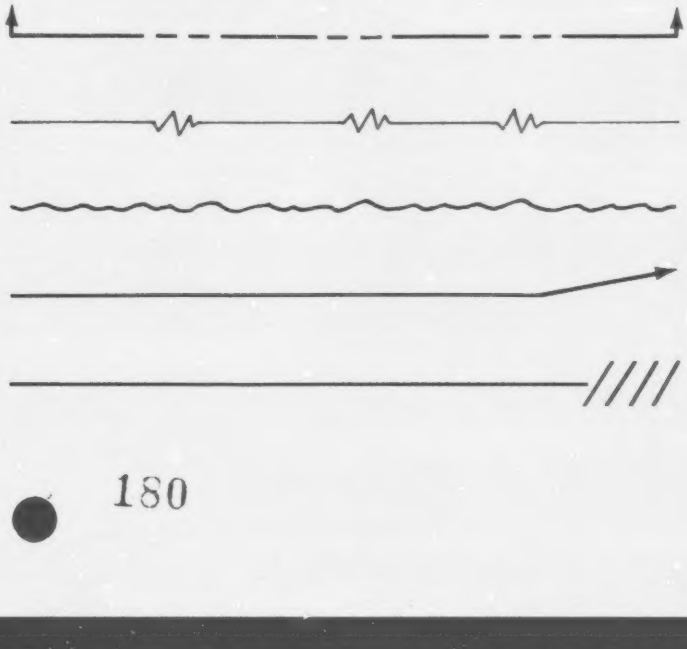

Asbestos Siding 10" Exp.
2"x8" Joist
4"x6" Sill
Water Table
5/8" Anchor Bolt
Grade
Foundation Wall

SECTION THRU SILL

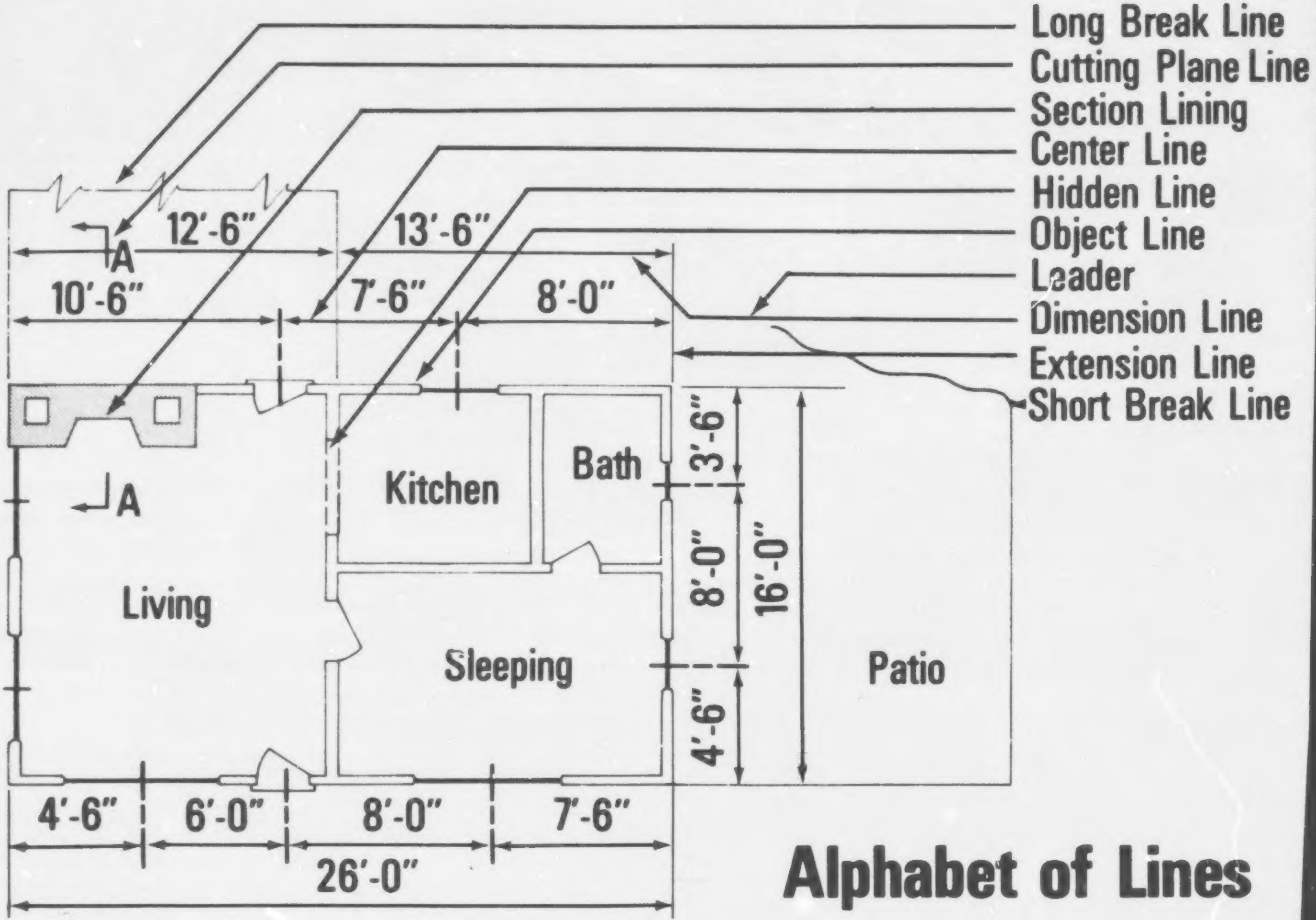

Rafter
2"x8"
2-2"x4" Plate

SECTION THRU CORNICE

Alphabet of Lines

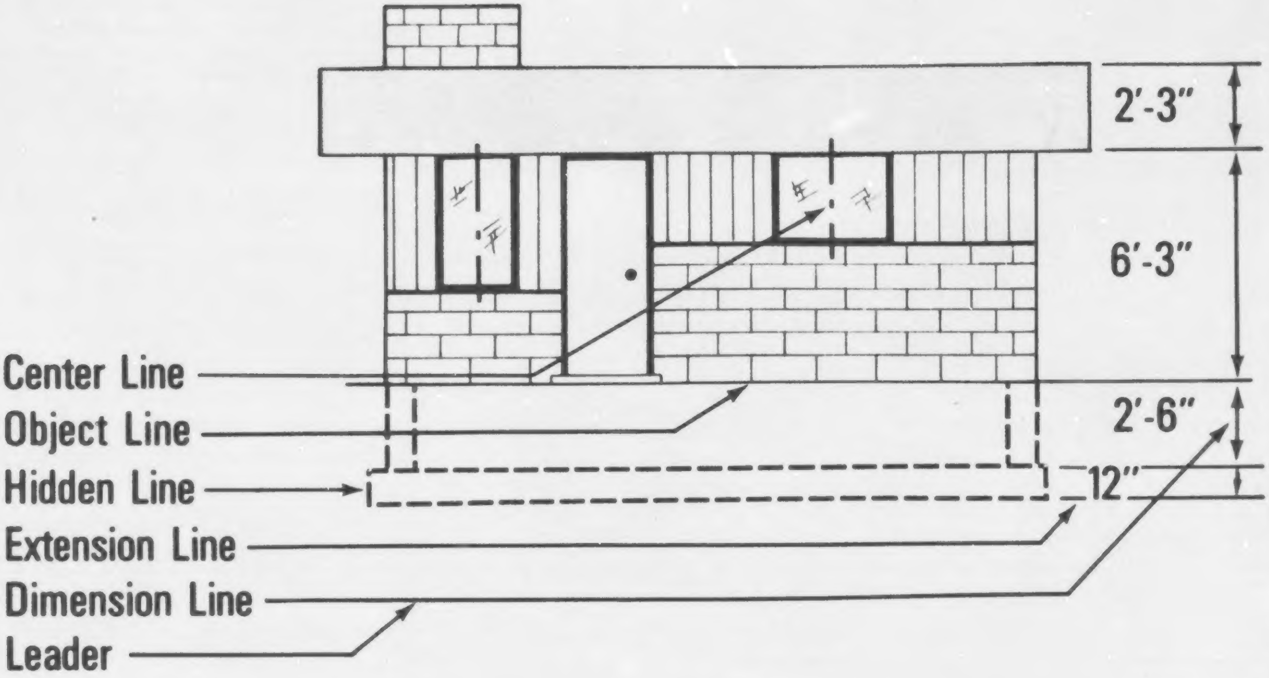


Object Line
Dimension Line
Extension Line
Hidden Line
Center Line
Cutting Plane
Break Line-Long
Break Line-Short
Leader
Section Lining

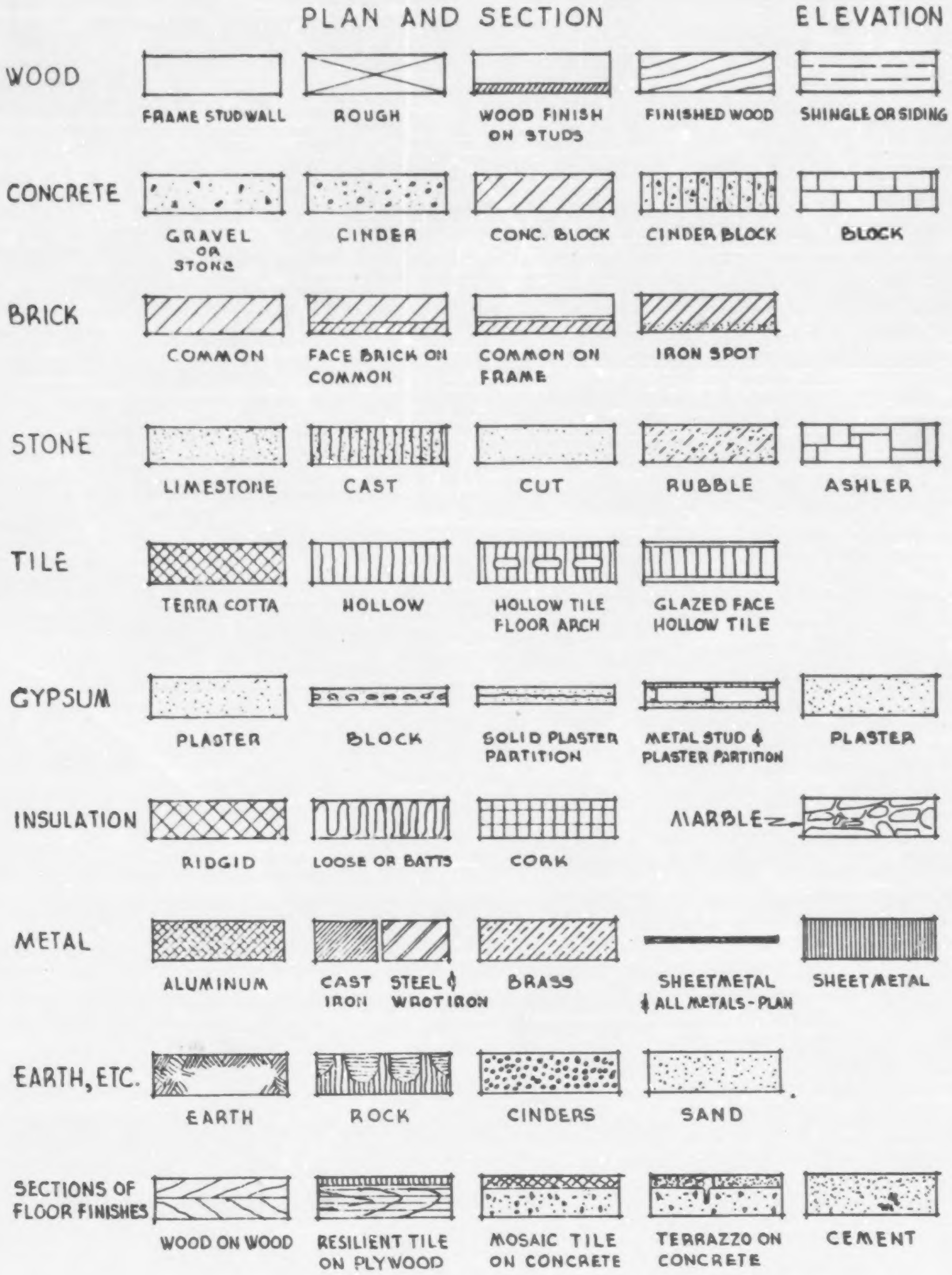

Long Break Line
Cutting Plane Line
Section Lining
Center Line
Hidden Line
Object Line
Leader
Dimension Line
Extension Line
Short Break Line
12'-6"
13'-6"
A
10'-6"
7'-6"
8'-0"
Kitchen
Bath
A
Living
Sleeping
Patio
3'-6"
8'-0"
16'-0"
4'-6"
4'-6"
6'-0"
8'-0"
7'-6"
26'-0"

Alphabet of Lines

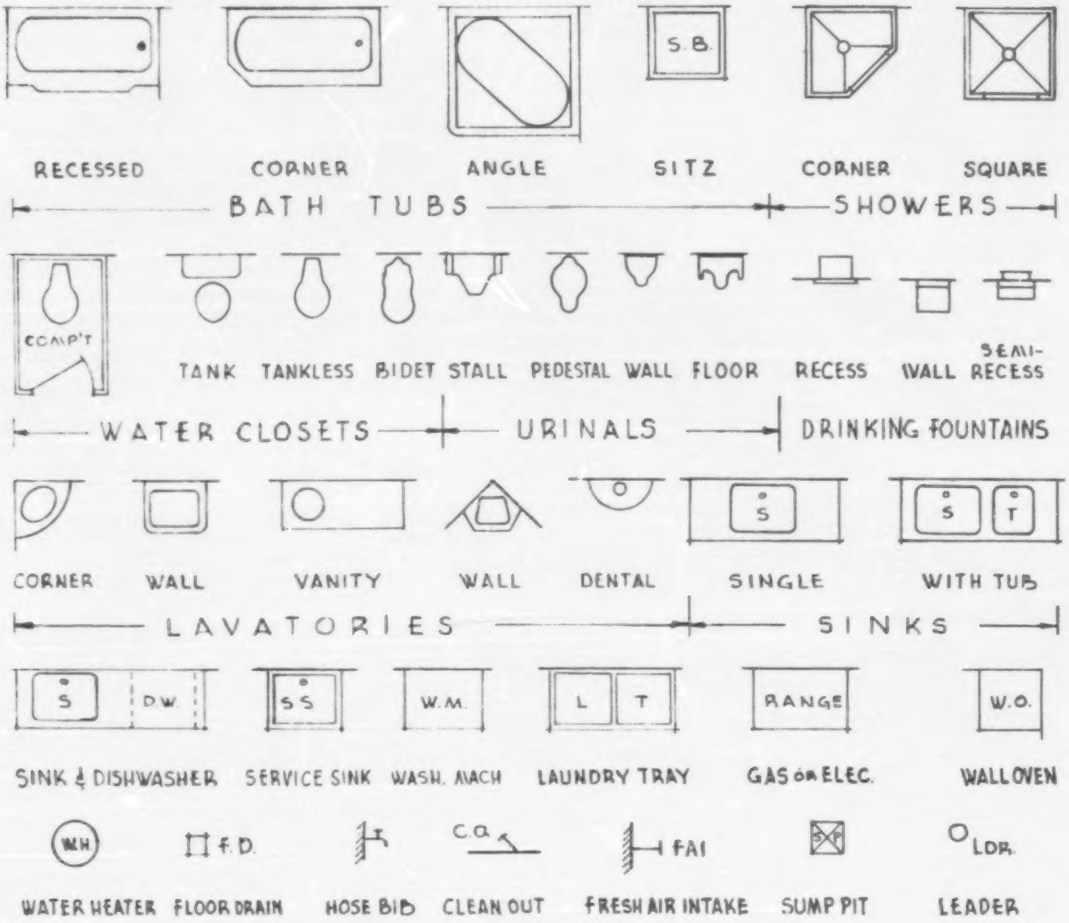
Alphabet of Lines


2'-3"
6'-3"
2'-6"
12"
Center Line
Object Line
Hidden Line
Extension Line
Dimension Line
Leader

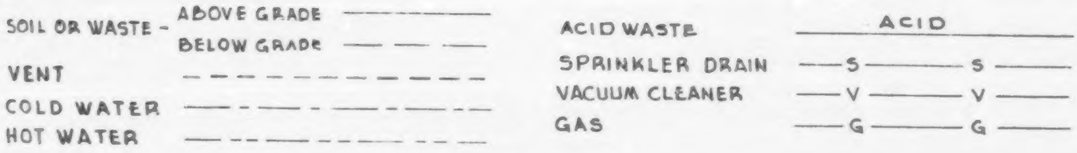
Architectural Symbols


PLAN AND SECTION
ELEVATION
WOOD
FRAME STUDWALL
ROUGH
WOOD FINISH ON STUDS
FINISHED WOOD
SHINGLE OR SIDING
CONCRETE
GRAVEL OR STONE
CINDER
CONC. BLOCK
CINDER BLOCK
BLOCK
BRICK
COMMON
FACE BRICK ON COMMON
COMMON ON FRAME
IRON SPOT
STONE
LIMESTONE
CAST
CUT
RUBBLE
ASHLER
TILE
TERRA COTTA
HOLLOW
HOLLOW TILE FLOOR ARCH
GLAZED FACE HOLLOW TILE
GYPSUM
PLASTER
BLOCK
SOLID PLASTER PARTITION
METAL STUD & PLASTER PARTITION
PLASTER
INSULATION
RIDGID
LOOSE OR BATTS
CORK
MARBLE
METAL
ALUMINUM
CAST IRON
STEEL & WROT IRON
BRASS
SHEETMETAL & ALL METALS-PLAN
SHEETMETAL
EARTH, ETC.
EARTH
ROCK
CINDERS
SAND
SECTIONS OF FLOOR FINISHES
WOOD ON WOOD
RESILIENT TILE ON PLYWOOD
MOSAIC TILE ON CONCRETE
TERRAZZO ON CONCRETE
CEMENT

Plumbing and Piping Symbols

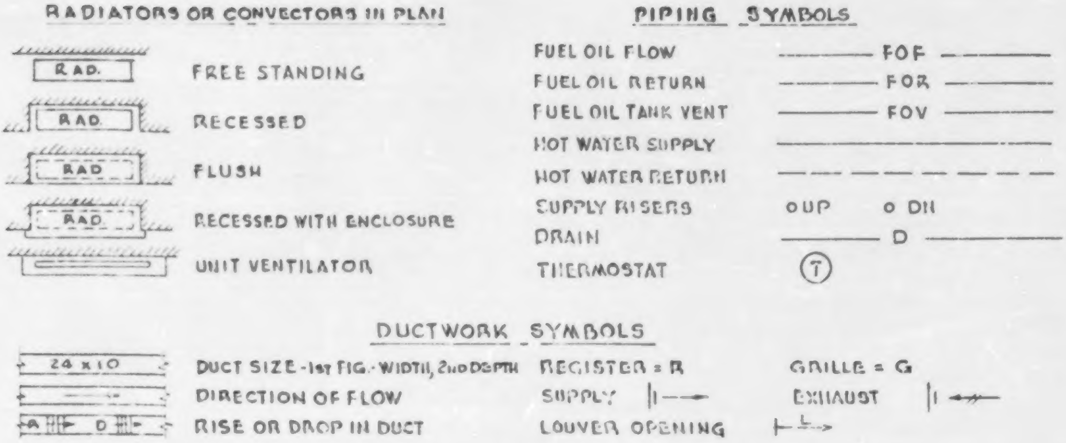

S.B.
RECESSED
CORNER
ANGLE
SITZ
CORNER
SQUARE
BATH TUBS
SHOWERS
COMP'T
TANK
TANKLESS
BIDET
STALL
PEDESTAL
WALL
FLOOR
RECESS
WALL
SEMI-RECESS
WATER CLOSETS
URINALS
DRINKING FOUNTAINS
S
S
T
CORNER
WALL
VANITY
WALL
DENTAL
SINGLE
WITH TUB
LAVATORIES
SINKS
S
D.W.
S S
W.M.
L
T
RANGE
W.O.
SINK & DISHWASHER
SERVICE SINK
WASH. MACH
LAUNDRY TRAY
GAS OR ELEC.
WALL OVEN
W.H.
F.D.
C.O.
FAI
LDR.
WATER HEATER
FLOOR DRAIN
HOSE BIB
CLEAN OUT
FRESH AIR INTAKE
SUMP PIT
LEADER

Plumbing symbols.

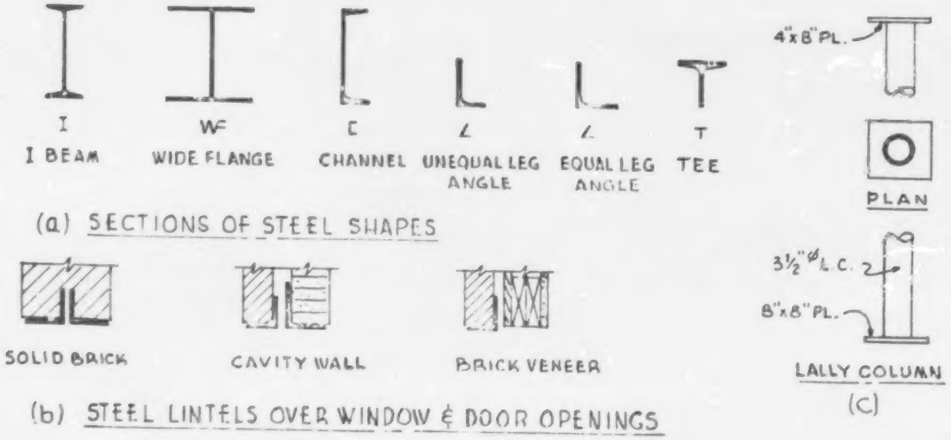

SOIL OR WASTE -
ABOVE GRADE
BELOW GRADE
VENT
COLD WATER
HOT WATER
ACID WASTE
ACID
SPRINKLER DRAIN
S
S
VACUUM CLEANER
V
V
GAS
G
G

Piping symbols.

Ductwork and Structural Symbols

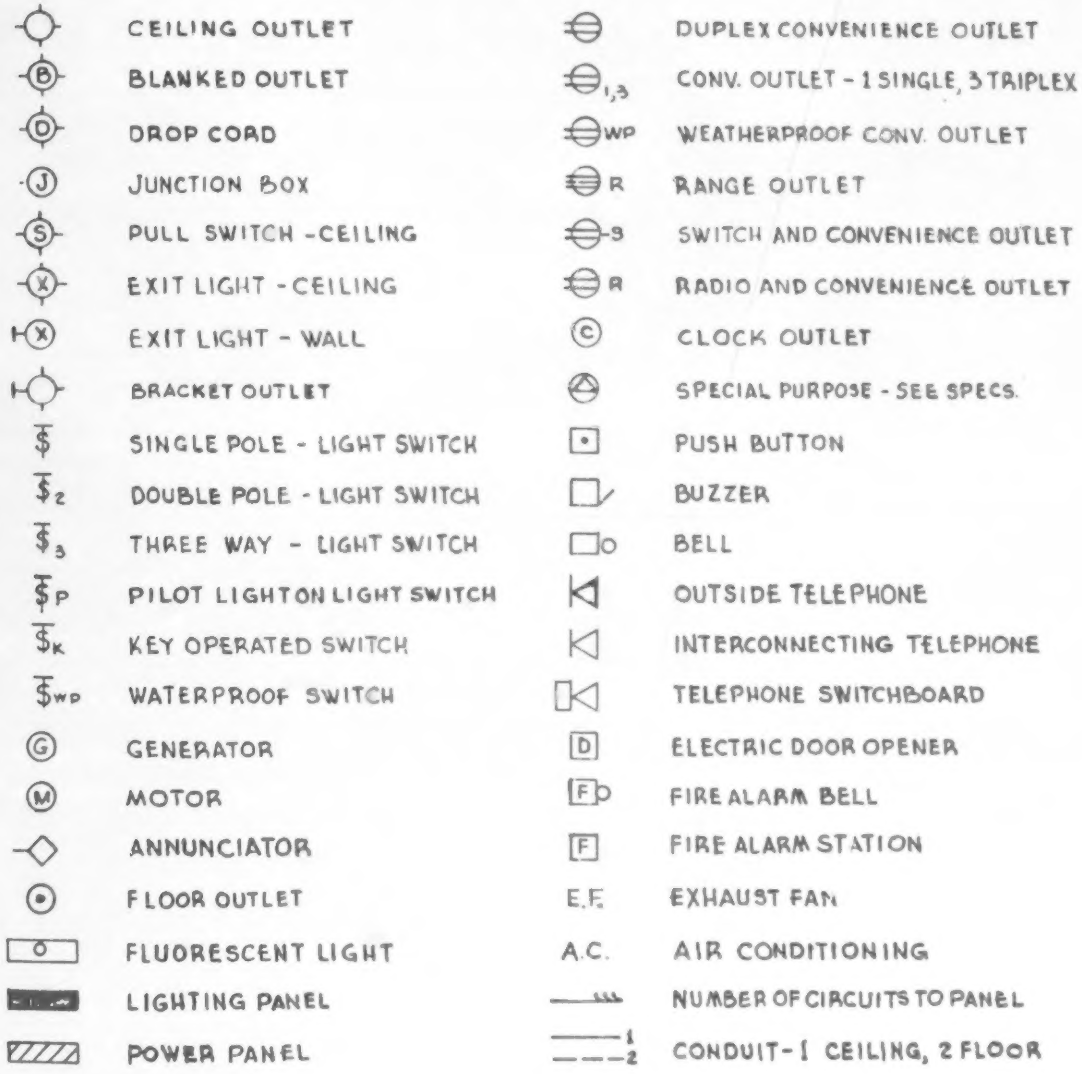

RADIATORS OR CONVECTORS IN PLAN
RAD.
FREE STANDING
RAD.
RECESSED
RAD
FLUSH
RAD.
RECESSED WITH ENCLOSURE
UNIT VENTILATOR
PIPING SYMBOLS
FUEL OIL FLOW
FOF
FUEL OIL RETURN
FOR
FUEL OIL TANK VENT
FOV
HOT WATER SUPPLY
HOT WATER RETURN
SUPPLY RISERS
o UP
o DN
DRAIN
D
THERMOSTAT
T
DUCTWORK SYMBOLS
24 x 10
DUCT SIZE-1st FIG.-WIDTH, 2nd DEPTH
DIRECTION OF FLOW
R
D
RISE OR DROP IN DUCT
REGISTER = R
SUPPLY
LOUVER OPENING
L
GRILLE = G
EXHAUST

Heating and ventilating symbols.


I
I BEAM
WF
WIDE FLANGE
[
CHANNEL
∠
UNEQUAL LEG ANGLE
∠
EQUAL LEG ANGLE
T
TEE
(a) SECTIONS OF STEEL SHAPES
4"x8" PL.
PLAN
3½"Ø L.C.
8"x8" PL.
LALLY COLUMN
(c)
SOLID BRICK
CAVITY WALL
BRICK VENEER
(b) STEEL LINTELS OVER WINDOW & DOOR OPENINGS

Structural symbols.

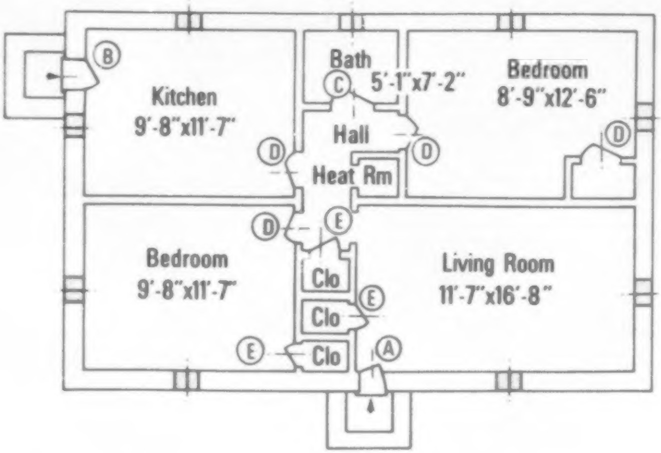
Electrical Symbols


CEILING OUTLET
BLANKED OUTLET
DROP CORD
JUNCTION BOX
PULL SWITCH - CEILING
EXIT LIGHT - CEILING
EXIT LIGHT - WALL
BRACKET OUTLET
SINGLE POLE - LIGHT SWITCH
DOUBLE POLE - LIGHT SWITCH
THREE WAY - LIGHT SWITCH
PILOT LIGHT ON LIGHT SWITCH
KEY OPERATED SWITCH
WATERPROOF SWITCH
GENERATOR
MOTOR
ANNUNCIATOR
FLOOR OUTLET
FLUORESCENT LIGHT
LIGHTING PANEL
POWER PANEL
DUPLEX CONVENIENCE OUTLET
CONV. OUTLET - 1 SINGLE, 3 TRIPLEX
WEATHERPROOF CONV. OUTLET
RANGE OUTLET
SWITCH AND CONVENIENCE OUTLET
RADIO AND CONVENIENCE OUTLET
CLOCK OUTLET
SPECIAL PURPOSE - SEE SPECS.
PUSH BUTTON
BUZZER
BELL
OUTSIDE TELEPHONE
INTERCONNECTING TELEPHONE
TELEPHONE SWITCHBOARD
ELECTRIC DOOR OPENER
FIRE ALARM BELL
FIRE ALARM STATION
E.F.
EXHAUST FAN
A.C.
AIR CONDITIONING
NUMBER OF CIRCUITS TO PANEL
CONDUIT - 1 CEILING, 2 FLOOR

Electrical symbols.

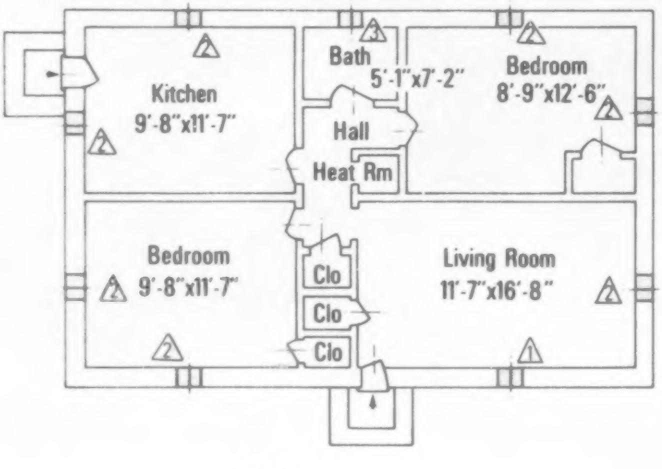
Door Schedule

Symbol	Width	Height	Thickness	Material	Type	Screen	Quantity	Threshold	Finish	Manufacturer
Ⓐ	3'0"	6'8"	1 3/4"	Ash	Solid	Aluminum Self-Storing Storm Door	1	Aluminum	Ext. Varnish	Ace Door Co.
Ⓑ	2'8"	6'8"	1 3/4"	Ash	Slab Core		1	Aluminum	Ext. Varnish	Ace Door Co.
Ⓒ	2'6"	6'8"	1 3/8"	Ash	Hollow Core	No	1	No	Int. Varnish	–
Ⓓ	2'8"	6'8"	1 3/8"	Ash	Hollow Core	No	4	No	Int. Varnish	–
Ⓔ	2'4"	6'8"	1 3/8"	Ash	Hollow Core	No	3	No	Int. Varnish	–


Ⓑ
Kitchen
9'-8"x11'-7"
Bath
Ⓒ
5'-1"x7'-2"
Bedroom
8'-9"x12'-6"
Hall
Ⓓ
Ⓓ
Ⓓ
Heat Rm
Ⓓ
Ⓔ
Bedroom
9'-8"x11'-7"
Living Room
11'-7"x16'-8"
Clo
Clo
Ⓔ
Ⓔ
Clo
Ⓐ

Window Schedule

Symbol	Width	Height	Material	Type	Screen	Quantity	Remarks	Manufacturer	Catalog #
△1	5′ 0″	4′ 0″	Aluminum	Stationary	No	1		A&S Glass	54BW
△2	4′ 0″	4′ 0″	〃	Double Hung	Yes	7		A&S Glass	44DW
△3	3′ 0″	3′ 0″	〃	〃	〃	1	Frosted Glass	A&S Glass	33DW


△2
△3
Bath
5′-1″x7′-2″
△2
Bedroom
8′-9″x12′-6″
△2
△2
Kitchen
9′-8″x11′-7″
△2
Hall
Heat Rm
Bedroom
9′-8″x11′-7″
△2
Clo
Clo
Clo
Living Room
11′-7″x16′-8″
△2
△2
△1

BLUEPRINT READING FOR STRUCTURES

TEST

I. Match the terms listed below to the correct definition.

1. Set of conventional symbols covering all the lines needed to depict an object as to size and shape.
2. A scale or rule divided in several scales which have inch fractions equal to a foot.
3. A copy of the original detailed drawing.
4. A view of the product, with dimensions and other pertinent information required to make the part.
5. Are the front, rear and side views of a structure.
6. Horizontal cut through a building showing the foundation, room, partitions, windows, doors and stairs.
7. A drawing of an object which has been cut apart to show the interior construction or material.
8. The written description that accompanies a set of drawings and describes the work to be performed.
9. An arbitrary sign that has been standardized and is used to represent an object, quality or method.
10. A drawing or drawings that give the craftsman the necessary information to make and assemble a product.

___A. Symbols

___B. Architect's Scale

___C. Detail View

___D. Working Drawing

___E. Specifications

___F. Blueprint

___G. Alphabet Of Lines

___H. Elevation View

___I. Plan View

___J. Section View

II. List five types of architectural drawings.

A.

B.

C.

D.

E.

III. List the types of lines included in the alphabet of lines.

A.

B.

C.

D.

E.

F.

G.

H.

I.

IV. Identify the architectural, plumbing, piping, ductwork, structural and electrical symbols on the following pages by writing in the correct name by the symbols.

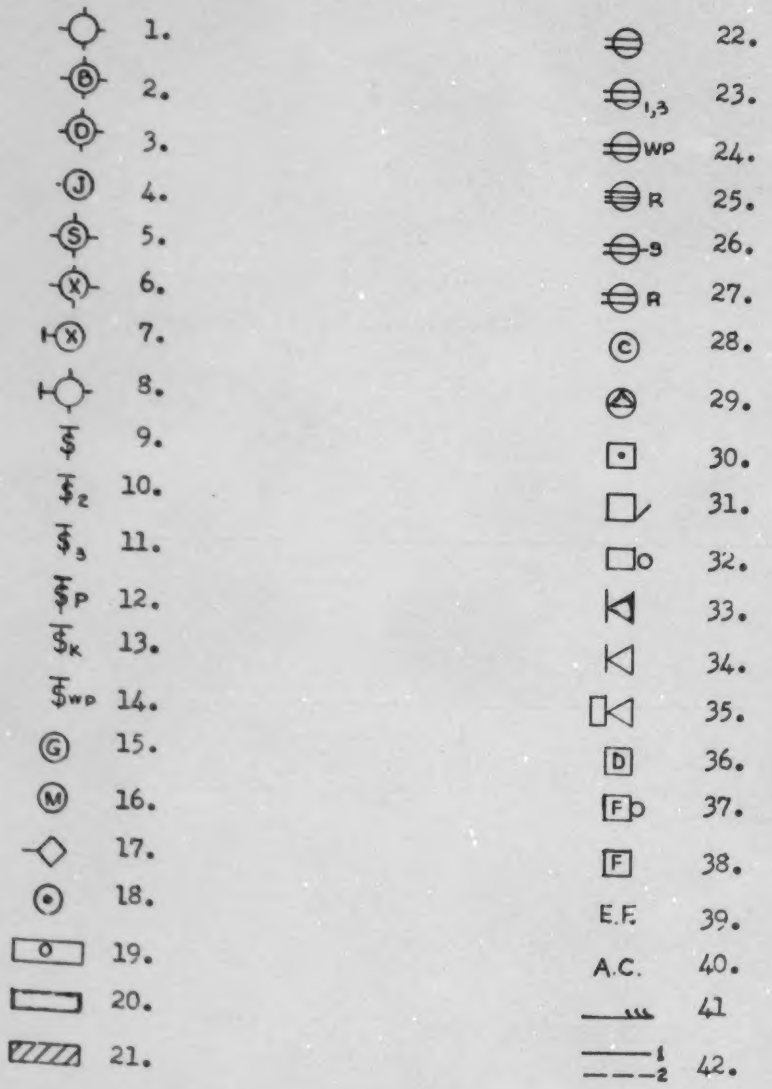

1.
B
2.
D
3.
J
4.
S
5.
X
6.
X
7.
8.
9.
2
10.
3
11.
P
12.
K
13.
WP
14.
G
15.
M
16.
17.
18.
19.
20.
21.
22.
1,3
23.
WP
24.
R
25.
S
26.
R
27.
C
28.
29.
30.
31.
32.
33.
34.
35.
D
36.
F
37.
F
38.
E.F.
39.
A.C.
40.
41
1
2
42.

Fig. 9·6 Electrical symbols.

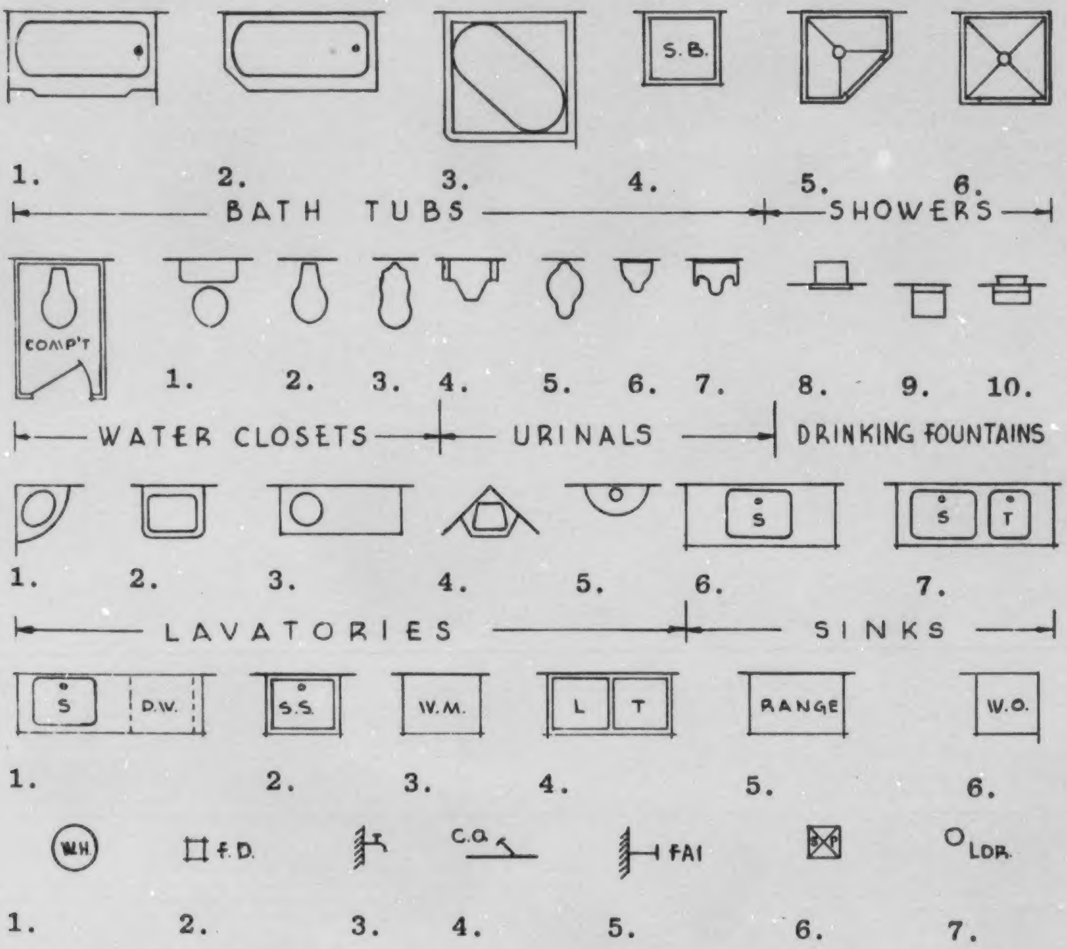

S.B.
1.
2.
3.
4.
5.
6.
BATH TUBS
SHOWERS
COMP'T
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
WATER CLOSETS
URINALS
DRINKING FOUNTAINS
S
S
T
1.
2.
3.
4.
5.
6.
7.
LAVATORIES
SINKS
S
D.W.
S.S.
W.M.
L
T
RANGE
W.O.
1.
2.
3.
4.
5.
6.
W.H.
F.D.
C.O.
FAI
S.P.
LDR.
1.
2.
3.
4.
5.
6.
7.

Fig. 9-2 Plumbing symbols.

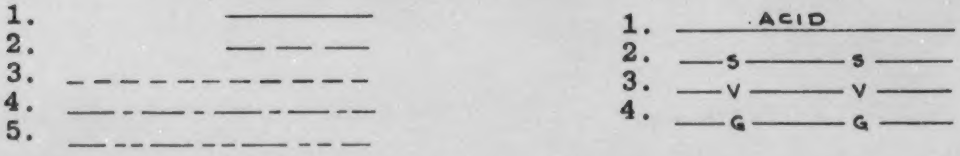
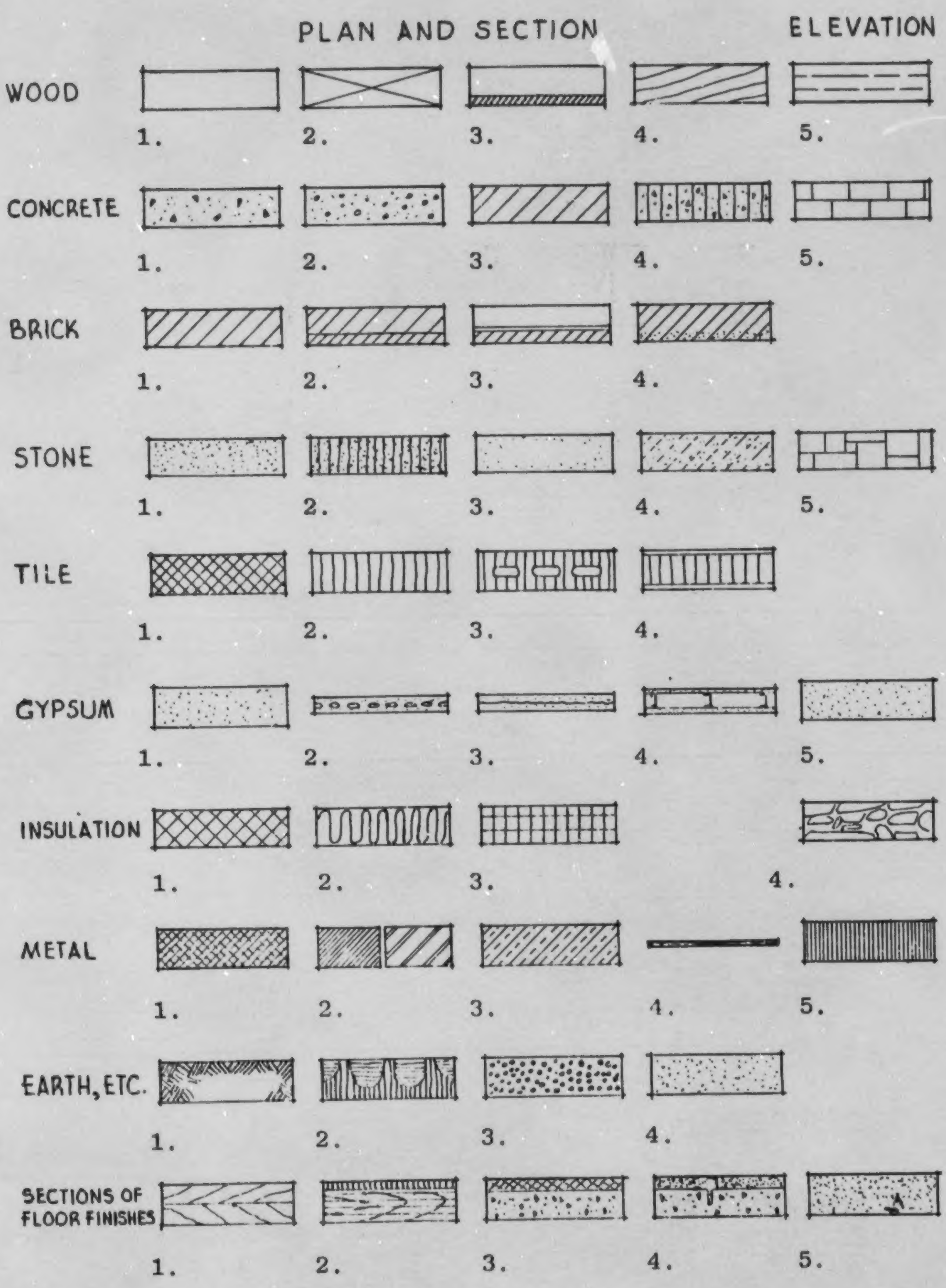
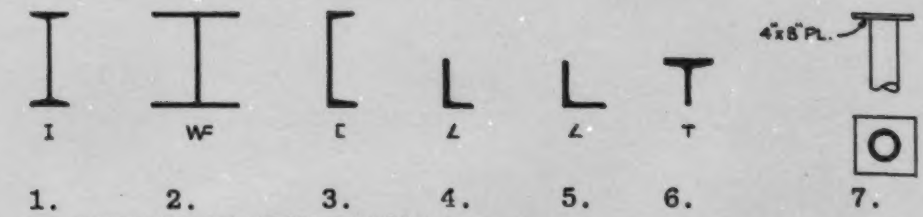

1.
2.
3.
4.
5.
1.
ACID
2.
S
S
3.
V
V
4.
G
G

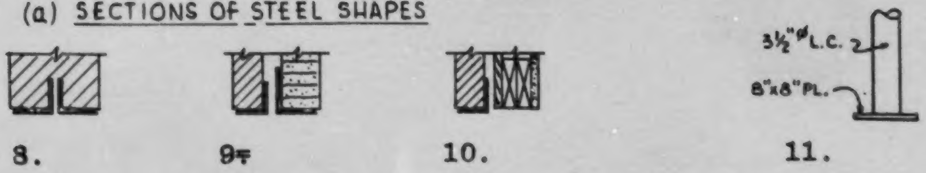
Fig. 9-3 Piping symbols.


PLAN AND SECTION
ELEVATION
WOOD
1.
2.
3.
4.
5.
CONCRETE
1.
2.
3.
4.
5.
BRICK
1.
2.
3.
4.
STONE
1.
2.
3.
4.
5.
TILE
1.
2.
3.
4.
GYPSUM
1.
2.
3.
4.
5.
INSULATION
1.
2.
3.
4.
METAL
1.
2.
3.
4.
5.
EARTH, ETC.
1.
2.
3.
4.
SECTIONS OF FLOOR FINISHES
1.
2.
3.
4.
5.

Architectural symbols.


4"x8" PL.
I
WF
[
∠
∠
T
1.
2.
3.
4.
5.
6.
7.

(a) SECTIONS OF STEEL SHAPES


3½"⌀ L.C.
8"x8" PL.
8.
9.
10.
11.

(b) STEEL LINTELS OVER WINDOW & DOOR OPENINGS

Fig. 9-5 Structural symbols.

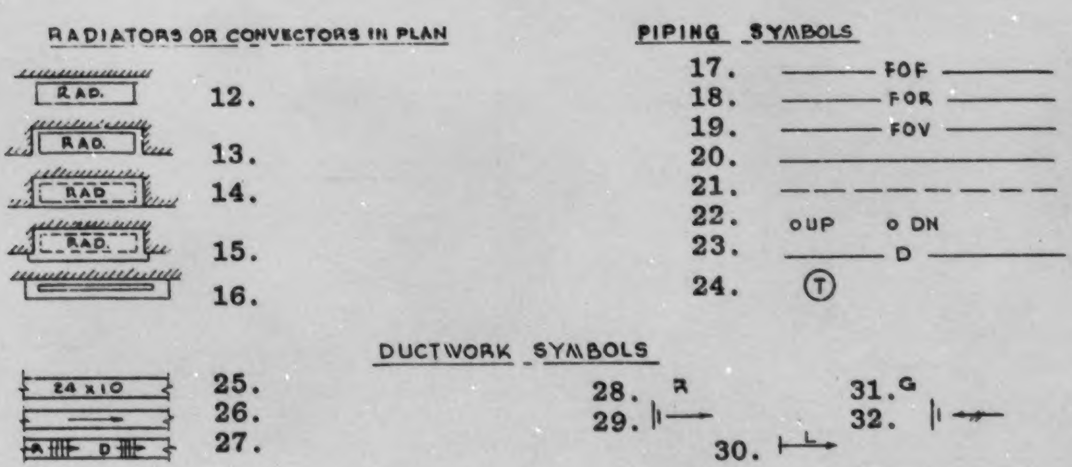

RADIATORS OR CONVECTORS IN PLAN
RAD.
12.
RAD.
13.
RAD.
14.
RAD.
15.
16.
PIPING SYMBOLS
17. FOF
18. FOR
19. FOV
20.
21.
22. UP DN
23. D
24. T
DUCTWORK SYMBOLS
24 x 10
25.
26.
R D
27.
28. R
29.
30. L
31. G
32.

Fig. 9-4 Heating and ventilating symbols.

V. List 12 scales on an architect scale.

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

L.

VI. Extract specific information from a prepared set of building specifications.

A.

B.

C.

D.

BLUEPRINT READING FOR STRUCTURES

ANSWERS TO TEST

I. A. 9
B. 2
C. 4
D. 10
E. 8
F. 3
G. 1
H. 5
I. 6
J. 7

II. A. Plot Plan
B. Foundation Plan
C. Floor Plan
D. Elevation
E. Details

III. A. Object Lines
B. Dimension Lines
C. Extension Lines
D. Hidden Lines
E. Center Lines
F. Cutting Plane Lines
G. Section Lines
H. Break Lines
I. Leaders

IV. Refer to TM 9 - 11.

V. A. 12" = 1' - 0"
B. 6" = 1' - 0"
C. 3" = 1' - 0"
D. 1½" = 1' - 0"

E. 1" = 1' - 0"
F. 3/4" = 1' - 0"
G. ½" = 1' - 0"
H. 3/8" = 1' - 0"
I. ¼" = 1' - 0"
J. 3/16" = 1' - 0"
K. 1/8" = 1' - 0"
L. 3/32" = 1' - 0"

VI. A. Door Schedule
B. Window Schedule
C. Paint Schedule
D. Materials Schedule

SECTION F

UNIT I

PLUMBING

PLUMBING

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to match terms to the correct definition and state common materials and practices used in the plumbing trade. This knowledge will be evidenced by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with farm plumbing to the correct definition.

II. Name five kinds of pipe used to carry water in farm plumbing.

III. Describe three types of drainage and vent pipes.

IV. List ten common fittings used in plumbing.

V. List tools used in plumbing work.

VI. List four jobs which must be done in plumbing work.

VII. List steps in sweating copper tubing.

VIII. List three materials from which plumbing fixtures are made.

IX. Name the four parts of a modern sewage system.

X. List three sewage treatment processes.

XI. List three materials from which septic tanks can be constructed.

XII. List four specifics concerning sewer and septic tank.

XIII. Identify 16 plumbing symbols.

XIV. Design a sewer system for a typical farm dwelling.

PLUMBING

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and assignment sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Give test.

II. Student:

  A. Read objective sheet.

  B. Study information sheets.

  C. Complete assignment sheet.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1 - Common Pipe Fittings

    2. TM 2 - Plumbing Symbols

  D. Assignment sheet

    1. Assignment sheet #1 - Design A Sewer System

  E. Answers to assignment sheets

  F. Test

G. Answers to test

II. References:

A. Wakeman, T.J. and McCoy, Vernon Lee, The Farm Shop, The MacMillan Co., 1960.

B. Phipps, Lloyd J., Mechanics In Agriculture, Danville, Illinois, The Interstate Printers and Publishers, Inc., 1967.

PLUMBING

INFORMATION SHEET

I. Terms and definitions.

   A. PLUMBING - The piping and pipe attachments used to carry water into buildings and to drain away sewage and waste.

   B. FITTINGS - Pieces used to join pipes, to provide openings in them and to change their direction.

   C. FIXTURES - The appliances connected to the plumbing.

   D. TRAP - Water sealed bend or chamber in a waste pipe. It is located in or near a fixture.

   E. HOUSE DRAIN - Pipe which carries all the sewage from the house.

   F. WASTE PIPES - Small pipes used to carry waste from sources other than closet bowls and urinals.

   G. STOCK - A soil, waste or ventilating pipe and is defined by its use.

   H. SEDIMENTATION - Separation of solids from liquids.

   I. DECOMPOSITION - Liquefaction of sewage.

   J. PURIFICATION - Aeration of the liquid sewage as it percolates.

II. Kinds of pipe used to carry water.

   A. Lead Pipe

   B. Wrought Iron

   C. Cast Iron Pipe

   D. Plastic Pipe

   E. Copper Tubing.

III. Types of drainage and vent pipe.

   A. Sewer Pipe - Made of vitrified clay or concrete of rather large diameter.

INFORMATION SHEET

B. Drain Pipe - For soil waste and vent, within a building usually made of iron or steel. Nickle plated brass tubing is used for exposed.

C. Soil Pipe - Made of cast iron, one end is bell shaped and the joints of soil pipe caulked.

D. Plastic - Corrosive resistant pipe used for interior piping stock and for field lines.

IV. Common fittings used in plumbing. TM 1

A. Bushing
B. 90° Elbow
C. Cap
D. Plug
E. 45° Elbow
F. Coupling
G. Bell Reducer
H. Straight Cross
I. 90° Street Elbow
J. Tee
K. Union
L. "Y"
M. Long Nipple
N. Short Nipple
O. Close Nipple
P. Globe Valve
Q. Gate Valve
R. Gas Top
S. Nose Compression Faucet

V. Tools used in plumbing work.

A. Melting Pot
B. Pouring Laddle
C. Caulking Tools
D. Pipe Vise
E. Pipe Cutter
F. Pipe Threader
G. Reamer
H. Machine Oil
I. Pipe Wrench
J. Hammer
K. File
L. Hacksaw
M. Measuring Tape
N. Pipe Bender

INFORMATION SHEET

VI. Jobs which must be done in plumbing work.

- A. Measuring Pipe
- B. Marketing Pipe
- C. Cutting Pipe
- D. Reaming Pipe
- E. Threading Pipe
- F. Assembling Pipe

VII. Steps in sweating copper tubing.

- A. Cut the tubing squarely.
- B. Clean the inside and outside of the end of the tubing and fitting with fine steel wool.
- C. Apply the flux to the tubing and insert the tubing into the fitting.
- D. Revolve the tubing in the fitting to distribute the flux.
- E. Heat the fitting until it will melt the solder.
- F. Flow solder into the joint between the fitting and the tubing.
- G. Wipe the joint with a damp rag when the solder has set.

VIII. Three materials from which plumbing fixtures are made.

- A. Enameled Cast Iron
- B. Vitreous Ware (fused china clay)
- C. Stainelss Steel

IX. The four parts of a modern sewage system.

- A. Sewer to the septic tank.
- B. Septic tank
- C. Outlet sewer
- D. Final disposal system

INFORMATION SHEET

X. Three sewage treatment processes.

   A. Sedimentation

   B. Decomposition

   C. Purification

XI. Three materials from which septic tanks are made.

   A. Concrete

   B. Vitrified Tile

   C. Metal

XII. Four specifics concerning sewers and septic tanks.

   A. Tiles should be laid straight and at a uniform grade of not less than 2 feet of fall per 100 feet of tile.

   B. Sewer tile should be used with the hobs on the tile faced uphill and joints made tight with a rich cement mortar.

   C. The house sewer should be below the frost line.

   D. Septic tank should be at least 100 feet from any well.

XIII. Plumbing symbols.

   Refer to TM 2.

XIV. Designing a sewer system.

   A. The tank needs to be of sufficient size to hold the sewage for 70-hours or three days.

   B. The tanks should be located about 30 feet from the dwelling.

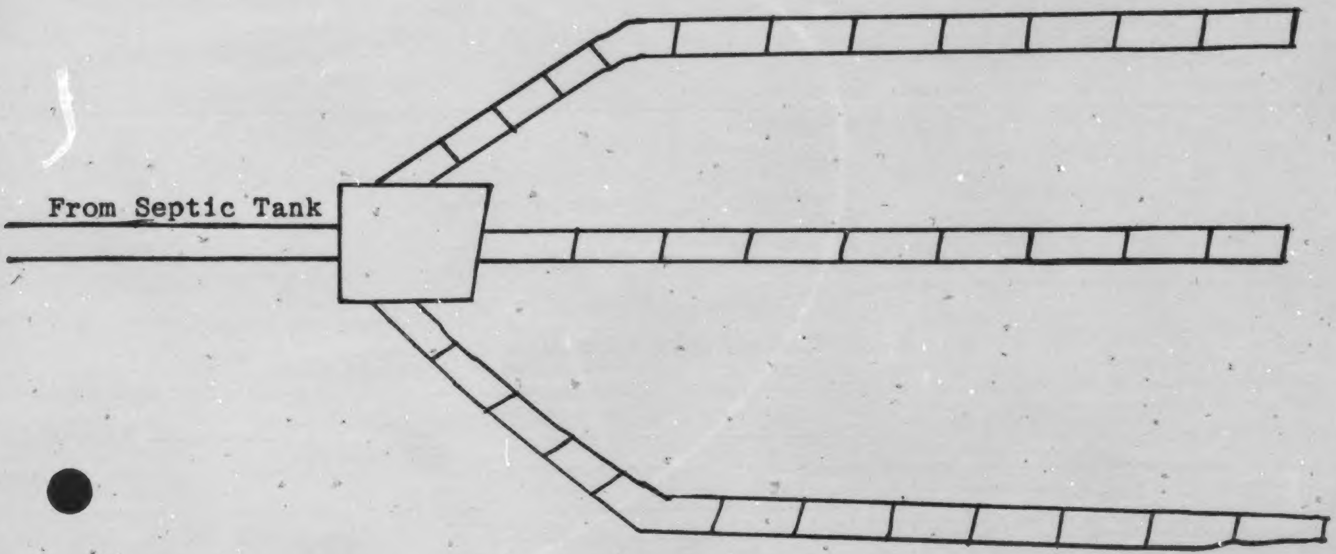
   C. The field line should be cemented at the joints until same distance from well or house.

   D. The drain tile should be at least four inches in diameter and buried at least four to six feet deep.

   E. The drain tile should have 20 to 50 feet of draining length per member of family.

INFORMATION SHEET

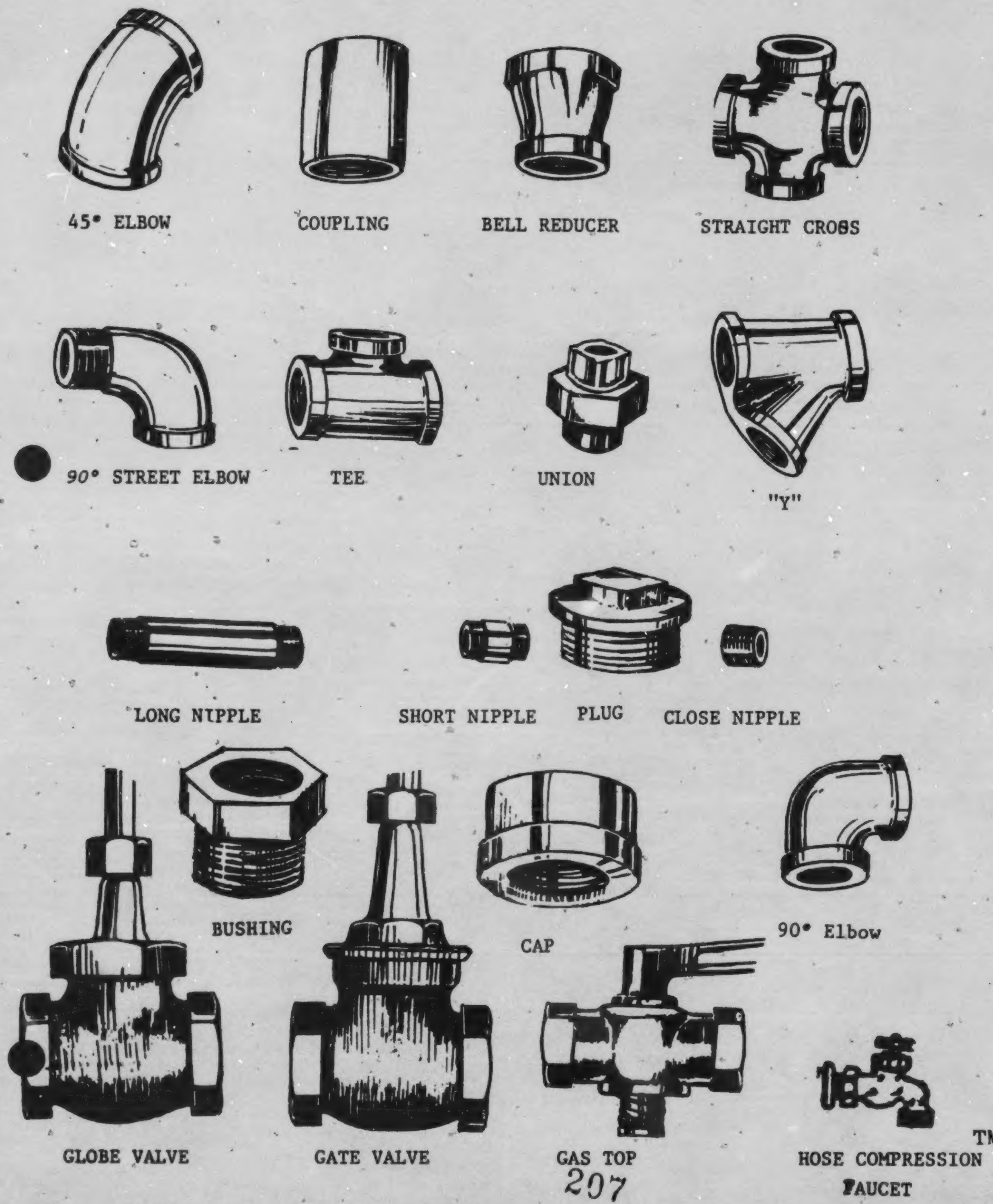
F. The first half should fall 6" - 10" per 100'. The last half should be 3" to 5" per 100'.



NOTE: If a sewer system is used within the city limits, the city building code should be checked.

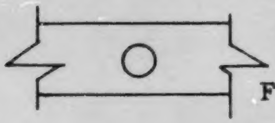
G. The drain tile should be buried in gravel for better absorption.

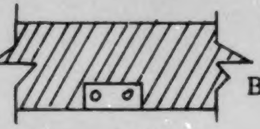
Common Pipe Fitting

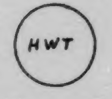

45° ELBOW
COUPLING
BELL REDUCER
STRAIGHT CROSS
90° STREET ELBOW
TEE
UNION
"Y"
LONG NIPPLE
SHORT NIPPLE
PLUG
CLOSE NIPPLE
BUSHING
CAP
90° Elbow
GLOBE VALVE
GATE VALVE
GAS TOP
HOSE COMPRESSION FAUCET

TM 1

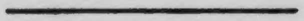
Plumbing Symbols

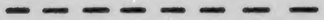

SOIL PIPE
FRAME WALL

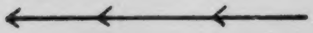

PIPE CHASE
BRICK WALL

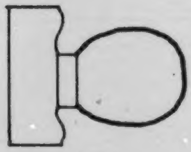


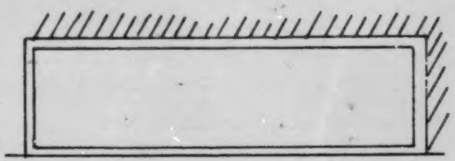
HOT WATER TANK

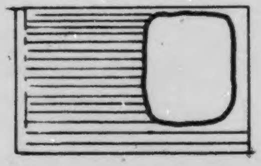

COLD WATER LINE

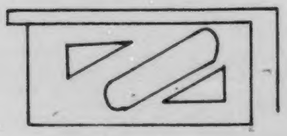

HOT WATER LINE

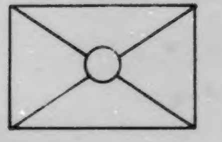

REFRIGERATOR LINE

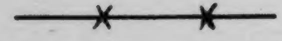

WATER CLOSET


BUILT - IN BATH TUB


COMBINATION TUB AND SINK


BATH TUB


FLOOR DRAIN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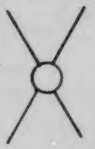
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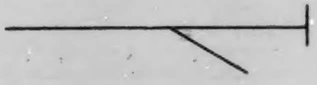
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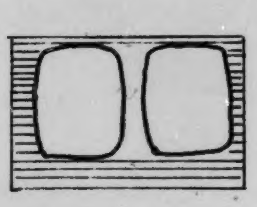
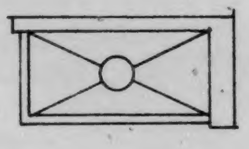

PANTRY


SHOWER

PLUMBING

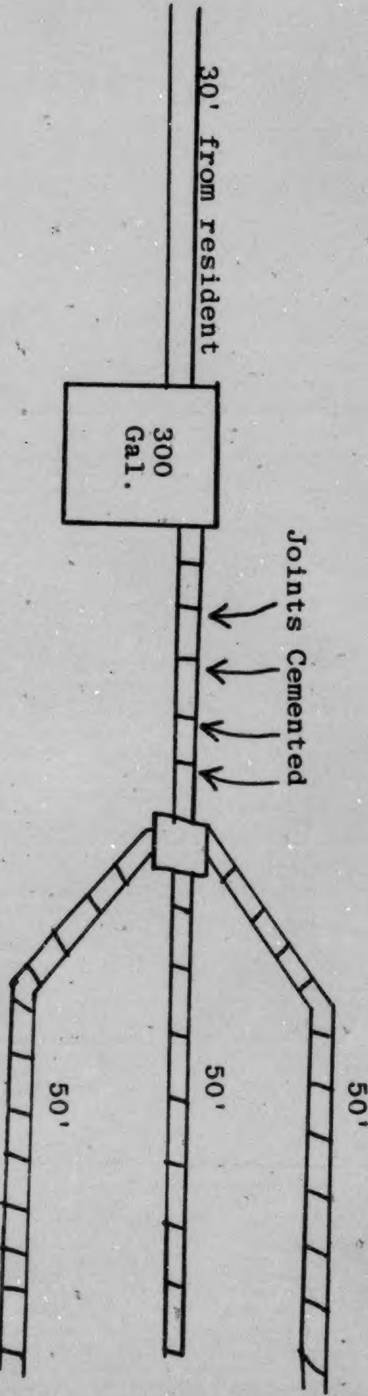
ASSIGNMENT SHEET #1 - DESIGN A SEWER SYSTEM

Design a sewer system for a rural family of five.

PLUMBING

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1


30' from resident
300 Gal.
Joints Cemented
50'
50'
50'

5 persons X 30 feet per person =
150 feet drain tile

Aerial view of drain tile

PLUMBING

TEST

I. Match the terms below to the correct definition.

1. The piping and pipe attachments used to carry water into buildings and to drain away sewage and waste.

2. Pieces used to join pipes, to provide openings in them and to change their direction.

3. The appliances connected to the plumbing.

4. Water sealed bend or chamber in a waste pipe. It is located in or near a fixture.

5. Pipe which carries all the sewage from the house.

6. Small pipes used to carry waste from sources other than closet bowls and urinals.

7. A soil, waste or ventilating pipe and is defined by its use.

8. Separation of solids from liquids.

9. Liquefaction of sewage.

10. Aeration of the liquid sewage as it percolates.

___A. Purification

___B. Plumbing

___C. Decomposition

___D. Fittings

___E. Sedimentation

___F. Fixtures

___G. House Drain

___H. Stock

___I. Waste Pipes

___J. Trap

II. Name five kinds of pipe used to carry water in farm plumbing.

A.

B.

C.

D.

E.

III. Describe three types of drainage and vent pipes.

A. Sewer Pipe -

B. Drain Pipe -

C. Plastic Pipe -

IV. List ten common fittings used in plumbing.

A.
B.
C.
D.
E.
F.
G.
H.
I.
J.

V. List tools used in plumbing work.

A.
B.
C.
D.
E.
F.
G.
H.
I.
J.
K.
L.
M.
N.

VI. List four jobs which must be done in plumbing work.

A.
B.
C.
D.

VII. List steps in sweating copper tubing.

A.
B.
C.
D.
E.
F.

G.

VIII. List three materials from which plumbing fixtures are made.

A.

B.

C.

IX. Name the four parts of a modern sewage system.

A.

B.

C.

D.

X. List three sewage treatment processes.

A.

B.

C.

XI. List three materials from which septic tanks can be made.

A.

B.

C.

XII. List four specifics concerning sewer and septic tanks.

A.

B.

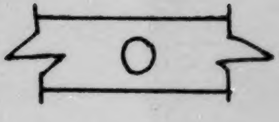
C.

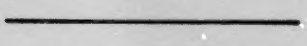
D.

XIII. Identify the 16 plumbing symbols on the following page.

XIV. Turn in assignment sheet #1.

PLUMBING


A.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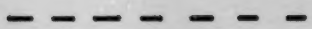
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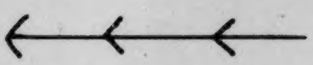
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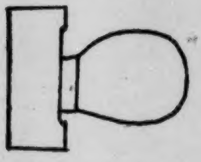
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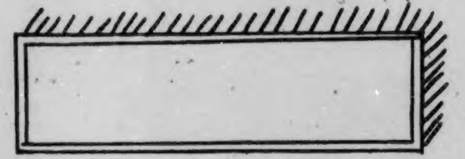
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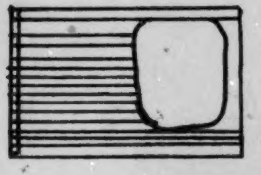
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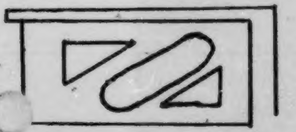
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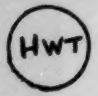
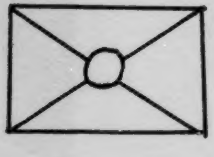


I.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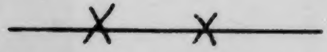
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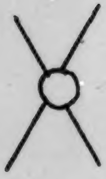
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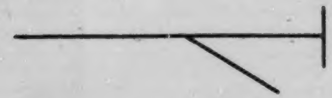
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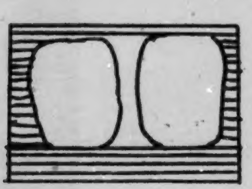
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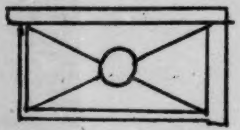
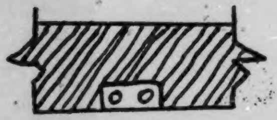

O.


P.

PLUMBING

ANSWERS TO TEST

I. A. 10

B. 1

C. 9

D. 2

E. 8

F. 3

G. 5

H. 7

I. 6

J. 4

II. A. Lead pipe

B. Wrought iron

C. Cast iron pipe

D. Plastic pipe

E. Copper tubing

III. A. Sewer Pipe - Made of vitrified clay or concrete of rather large diameter.

B. Drain Pipe - For soil waste and vent, within a building usually made of iron or steel. Nickle plated brass tubing is used for exposed.

C. Plastic - Corrosive resistant pipe used for interior piping, stock and for field lines.

IV. Any ten of the following:

A. Bushing

B. 90° Elbow

C. Cap

D. Plug

- E. 45° Elbow
- F. Coupling
- G. Bell Reducer
- H. Straight Cross
- I. 90° Street Elbow
- J. Tee
- K. Union
- L. "Y"
- M. Long Nipple
- N. Short Nipple
- O. Close Nipple
- P. Globe Valve
- Q. Gate Valve
- R. Gas Top
- S. Nose Compression Faucet

V. Any of the following:

- A. Melting Pot
- B. Pouring Laddle
- C. Caulking Tools
- D. Pipe Vise
- E. Pipe Cutter
- F. Pipe Threader
- G. Reamer
- H. Machine Oil
- I. Pipe Wrench
- J. Hammer
- K. File
- L. Hacksaw
- M. Measuring Tape
- N. Pipe Bender

VI. Any four of the following:

- A. Measuring Pipe
- B. Marking Pipe
- C. Cutting Pipe
- D. Reaming Pipe
- E. Threading Pipe
- F. Assembling Pipe

VII. A. Cut the tubing squarely.

B. Clean the inside and outside of the end of the tubing and fitting with fine steel wool.

C. Apply the flux to the tubing and insert the tubing into the fitting.

D. Revolve the tubing in the fitting to distribute the flux.

E. Heat the fitting until it will melt the solder.

F. Flow solder into the joint between the fitting and the tubing.

G. Wipe the joint with a damp rag when the solder has set.

VIII. A. Enameled cast iron

B. Vitreous ware

C. Stainless steel

IX. A. Sewer to the septic tank

B. Septic tank

C. Outlet sewer

D. Final disposal system

X. A. Sedimentation

B. Decomposition

C. Purification

XI. A. Concrete

B. Vitrified tile

C. Metal

XII. A. Tiles should be laid straight and at a uniform grade of not less than 2 feet of fall per 100 feet of tile.

B. Sewer tile should be used with the hubs on the tile faced uphill and joints made tight with a rich cement mortar.

C. The house sewer should be below the frost line.

D. Septic tank should be at least 100 feet from any well.

XIII. A. Soil pipe-frame wall

B. Cold water line

C. Hot water line

D. Refrigerator line

E. Water closet

F. Built-in bath tub

G. Combination tub and sink

H. Bath tub

I. Hot Water tank

J. Floor drain

K. Gas line

L. Shower drain

M. Cleanout

N. Pantry

O. Shower

P. Pipe chase-brick wall

XIV. To the satisfaction of the instructor.

SECTION G

UNIT I

ELECTRICITY

ELECTRICITY

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to wire certain residential wiring circuits. This knowledge will be evidenced through demonstration and learning schematic diagrams of the circuits and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with electricity.

II. Define a 240 volt service.

III. Wire a two-way switch.

IV. Wire a three-way switch.

V. Wire a four-way switch.

VI. Wire a series of three duplex receptacles.

VII. Wire a 240 volt special purpose outlet.

ELECTRICITY

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and job sheets.

  F. Give test.

  G. Review test by discussion.

II. Student:

  A. Read objective sheet.

  B. Study information sheets.

  C. Complete job sheets.

  D. Participate in class discussion concerning each job sheet.

  E. Take test.

  F. Review test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheets

  C. Transparency masters

    1. TM 1 - Two-Way Switch Diagram

    2. TM 2 - Three-Way Switch Diagram

    3. TM 3 - Four-Way Switch Diagram

        4. TM 4 - Three Duplex Receptacles
        5. TM 5 - Wiring A 240 Volt Outlet
    D. Job sheets
        1. Job sheet #1 - Wiring A Two-Way Switch
        2. Job sheet #2 - Wiring A Three-Way Switch
        3. Job sheet #3 - Wiring A Four-Way Switch
        4. Job sheet #4 - Wiring A Series of Three Duplex Receptacles
        5. Job sheet #5 - Wiring A 240 Volt Special Purpose Outlet
    E. Test
    F. Answers to test

II. References:

A. Richter, H.P., Practical Electrical Wiring, McGraw Hill Book Co., Inc., 1972.

B. Sears and Roebuck Co., Simplified Electric Wiring Handbook, Printed in U.S.A., 1969.

C. Richter, H.P., Wiring Simplified, The Interstate Printers and Publishers, Inc., 1974.

D. Mix, Floyd M., House Wiring Simplified, South Holland, The Goodheart Wilcox Co., Inc., 1973.

ELECTRICITY

INFORMATION SHEET

I. Terms and definitions.

A. 240 VOLT SERVICE - An electrical line which carries 240 volts.

B. SPECIAL PURPOSE OUTLET - An outlet wired for a stationary piece of equipment like a range, dryer, refrigerator, air conditioner, etc.

C. 240 VOLT SPECIAL PURPOSE OUTLET - An outlet wired for a piece of equipment usually stationary that requires 240 volts.

D. TWO WAY SWITCH - A device that opens or closes one wire of a circuit.

E. THREE-WAY SWITCH - A device that will open or close one wire of a circuit at two different locations.

F. FOUR-WAY SWITCH - A device, when used in conjunction with two three-way switches, will open or close one wire of a circuit from a third location.

G. JUNCTION BOX - A metal or plastic box installed in the ceiling to serve as a junction or mounting place for lighting fixtures.

H. SWITCHBOX - A metal or plastic box installed in the wall to serve as a junction box or a mounting place for an electrical device.

I. SOURCE WIRE - This is a wire that has both "hot" and "neutral" wires and carries the source for the circuit.

J. MAIN DISCONNECT SWITCH - Usually a fused switch that opens or closes the main feeders to a building.

K. CIRCUIT BREAKER - A device for over current protection that will open a circuit automatically and can be manually or automatically reset and used again.

L. HOT LINE - An energized wire.

M. SYSTEM GROUND - A line used in the building as the main ground wire.

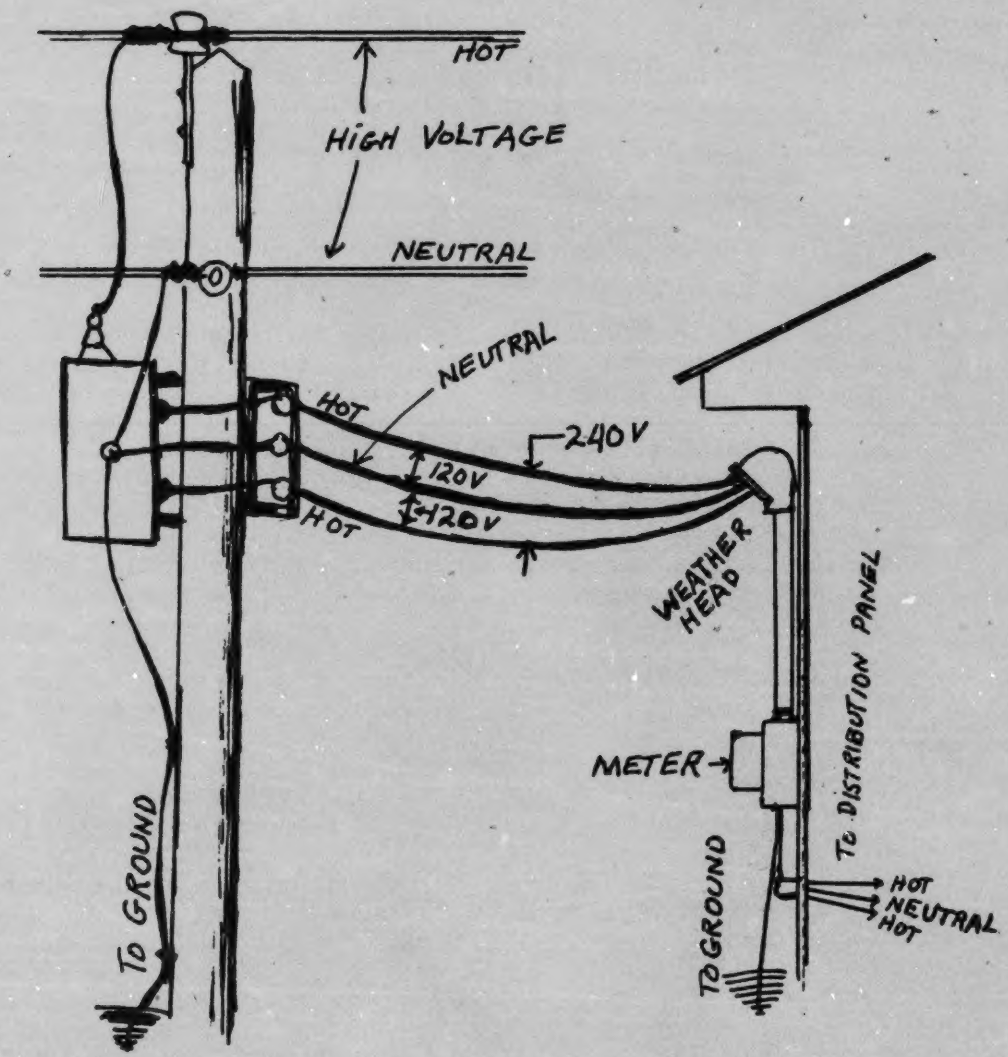
N. JUMPER WIRE - A short piece of wire used when a circuit has to continue without being broken. This wire is used frequently when wiring a series of

INFORMATION SHEET

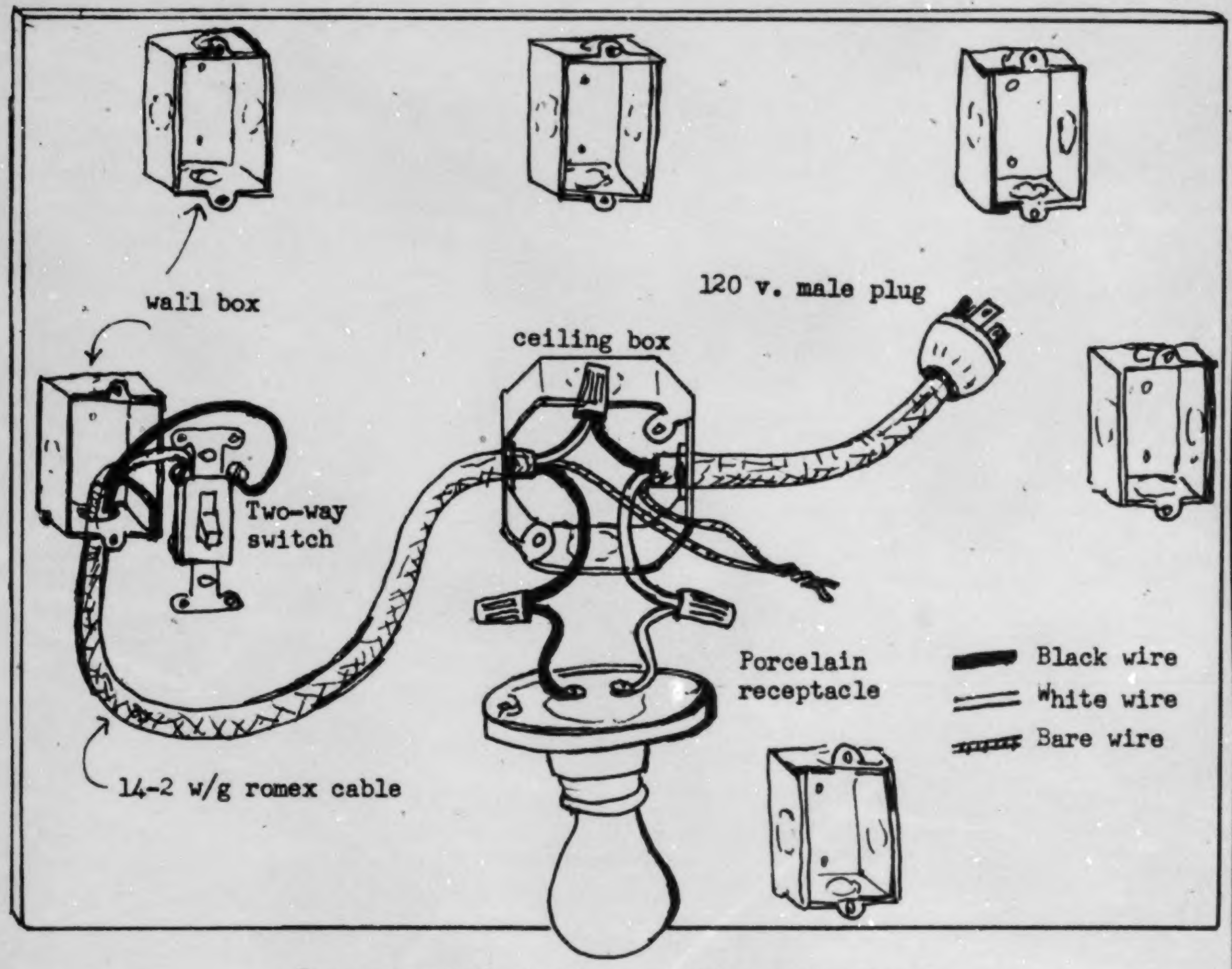
lights or the bare wire (equipment ground) is used.

II. A 240 Volt Service

A. A 240 volt service has three lines running to the residence. Two of the lines are "hot" lines which have 120 volts each. The other line is a neutral line which is used for the system ground.

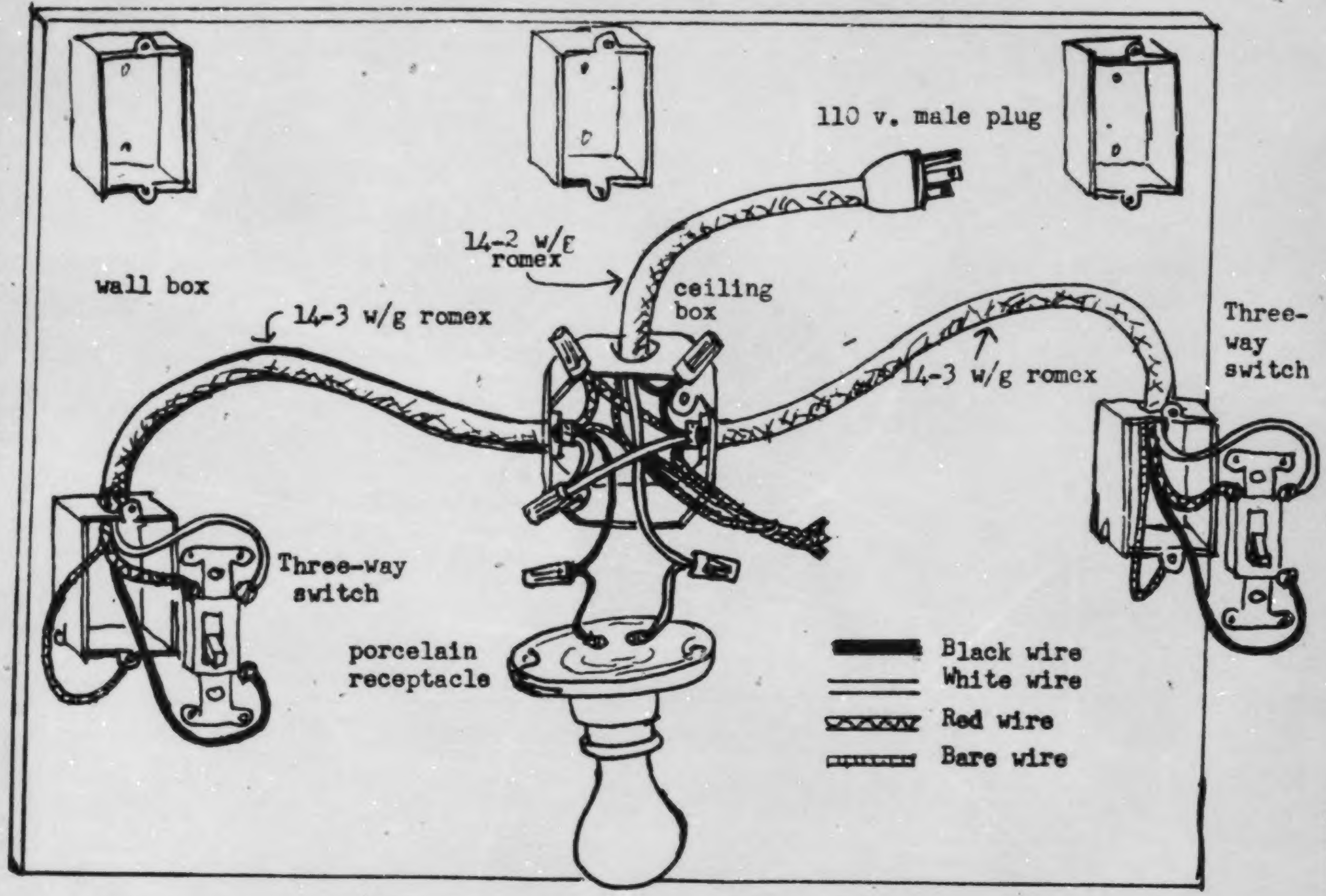

HOT
HIGH VOLTAGE
NEUTRAL
NEUTRAL
HOT
240V
120V
120V
HOT
WEATHER HEAD
TO DISTRIBUTION PANEL
METER
TO GROUND
TO GROUND
HOT
NEUTRAL
HOT

TWO-WAY SWITCH DIAGRAM


wall box
wall box
Two-way switch
ceiling box
120 v. male plug
Porcelain receptacle
14-2 w/g romex cable
Black wire
White wire
Bare wire

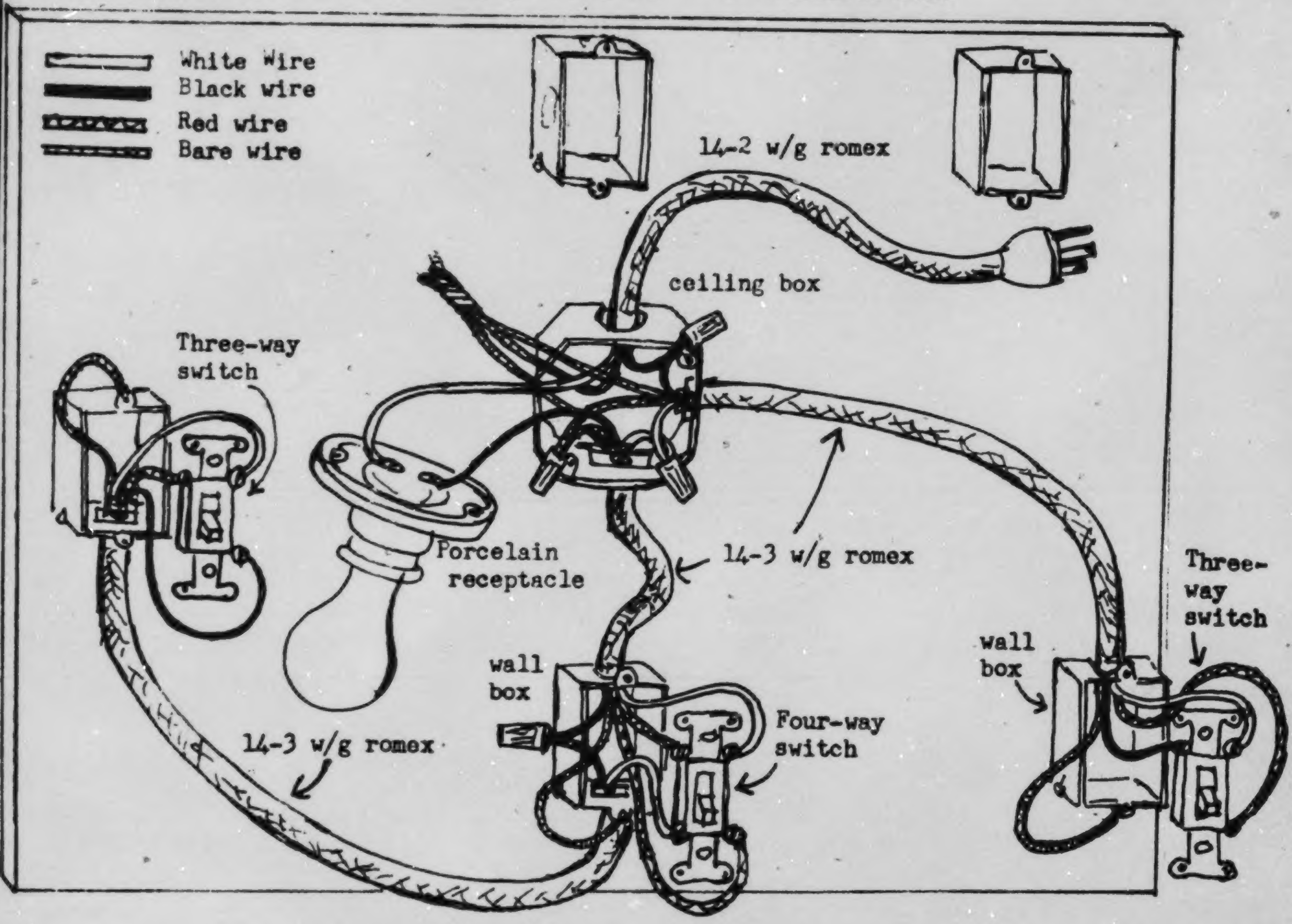
Two-way switch wired on practice wiring board.

THREE-WAY SWITCH DIAGRAM


110 v. male plug
14-2 w/g romex
wall box
ceiling box
14-3 w/g romex
Three-way switch
14-3 w/g romex
Three-way switch
porcelain receptacle
Black wire
White wire
Red wire
Bare wire

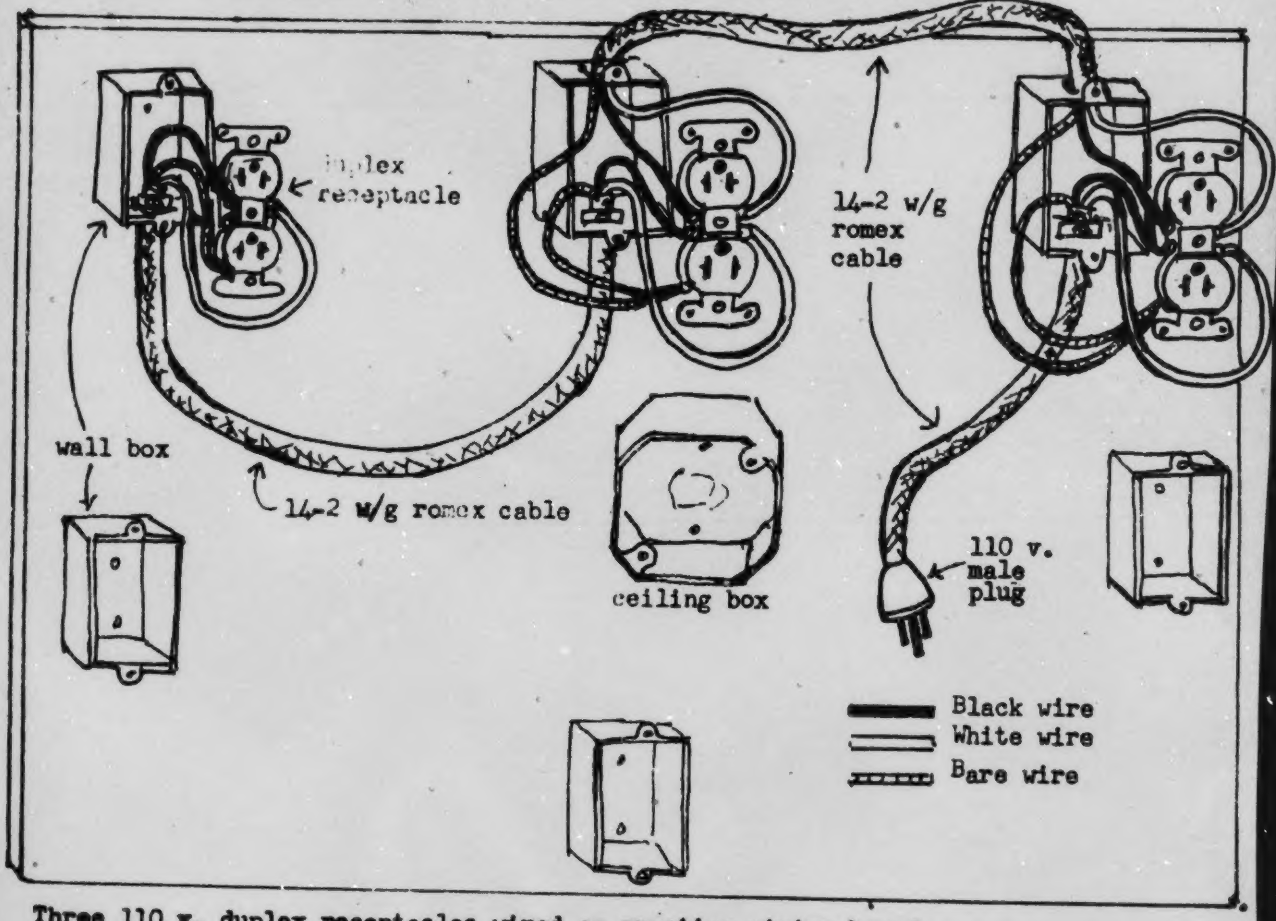
Three-way switches wired on practise wiring board.

FOUR-WAY SWITCH DIAGRAM


White Wire
Black wire
Red wire
Bare wire
14-2 w/g romex
ceiling box
Three-way switch
Porcelain receptacle
14-3 w/g romex
wall box
Four-way switch
14-3 w/g romex
wall box
Three-way switch

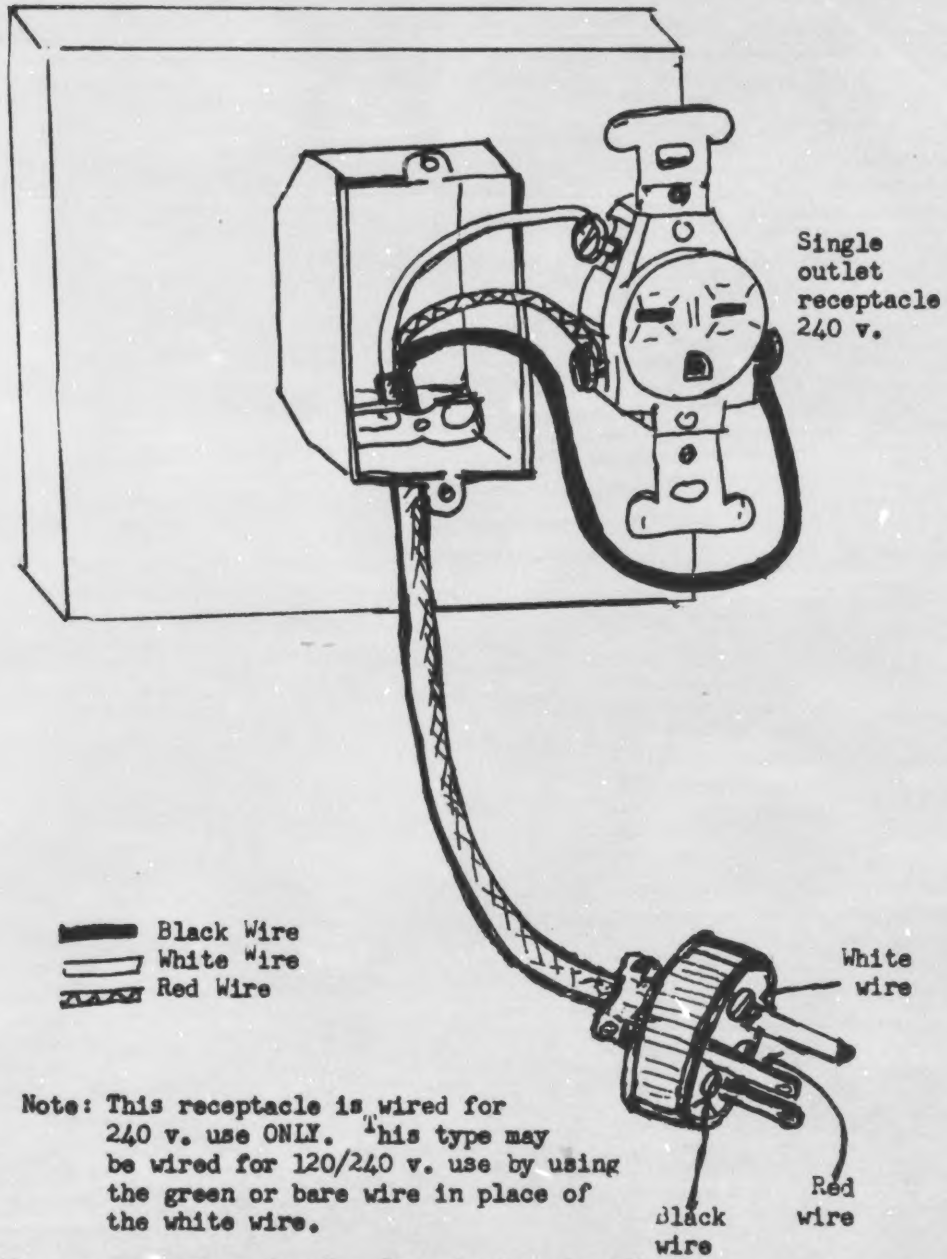
Four-way switch wired on practice wiring board.

THREE DUPLEX RECEPTACLES


duplex receptacle
14-2 w/g romex cable
wall box
14-2 w/g romex cable
ceiling box
110 v. male plug
Black wire
White wire
Bare wire

Three 110 v. duplex receptacles wired on practice wiring board.

WIRING A 240 VOLT OUTLET


Single outlet receptacle 240 v.
Black Wire
White Wire
Red Wire
White wire
Red wire
Black wire

Note: This receptacle is wired for 240 v. use ONLY. This type may be wired for 120/240 v. use by using the green or bare wire in place of the white wire.

240 v. receptacle and male plug wired on board.

ELECTRICITY

JOB SHEET #1 - WIRING A TWO-WAY SWITCH

I. Tools needed:

- A. Linesman pliers
- B. Needle nose pliers
- C. Romex cable ripper
- D. Wire strippers
- E. One switchbox
- F. One junction box
- G. Screwdriver

II. Materials needed:

- A. Two pieces of 14-2 WG NM Romex 18 inches long
- B. One two-way switch
- C. One porcelain lamp receptacle
- D. One 120 volt plug (three prone)
- E. One piece of plyboard 3/4" X 6" X 10"
- F. Four 3/4" No. 12 wood screws

III. Procedure:

- A. Fasten both the switchbox and junction box to plyboard 6" apart using the four wood screws.
- B. Rip both romex cables six inches from each end.
- C. Strip the insulation on both white and black wires on both cables one inch from the end.
- D. Put plug on one end of the source wire by attaching the black wire on the dark terminal, the white wire on the light terminal and the bare wire on the green terminal. The plug is attached only for testing purposes. When wiring a building, the source will come from the breaker box.

E. Attach romex to the switchbox and junction box with the romex fasteners located inside the box. Be sure to leave six inches out of the box.

Note: The source wire will be attached to the junction box only.

F. The white wire from source goes directly to one of the terminals from the porcelain receptacle.

G. The bare wires are spliced together with a jumper wire in the junction box. The jumper wire is grounded to the junction box.

H. Attach black and white wires to the terminals of the two-way switch. The bare wire will ground directly to the switchbox.

I. The black wire from source and the white wire from switch splice together in the junction box.

J. The black wire from switch goes to the other terminal on the porcelain receptacle.

Note: Use a solderless connector on all splices.

ELECTRICITY

JOB SHEET #2 - WIRING A THREE-WAY SWITCH

I. Tools needed:

A. Linesman pliers

B. Needle nose pliers

C. Romex cable ripper

D. Wire strippers

E. Two switchboxes

F. One junction box

G. Screwdriver

II. Materials needed:

A. One piece of 14-2 WG NM Romex 18 inches long

B. Two pieces of 14-3 WG NM Romex 18 inches long

C. Two three-way switches

D. One porcelain lamp receptacle

E. One 120 volt plug (three prone)

F. One piece of plyboard 3/4" X 6" X 18"

G. Six 3/4" No. 12 wood screws

III. Procedure:

A. Fasten both switchboxes and junction box to the plyboard six inches apart using the six wood screws.

B. Rip all three romex cables six inches from each end.

C. Strip the insulation on all wires on all three cables one inch from end.

D. Using the 14-2 WG NM romex cable as the source wire, attach the black wire to the dark terminal of the plug, the white wire to the light terminal and the bare wire to the green terminal of the plug.

E. Attach the other end of the source wire to the junction box leaving six inches out of the box.

F. Attach the 14-3 WG romex cables one to each switchbox. The other end of the cables will be attached to the junction box.

G. The white wire from source will go directly to one of the terminals on the porcelain receptacle.

H. The black wire from source will splice in the junction box with the black wire from the switch on the left. The black wire on the left switch is attached to the dark terminal.

I. Both three-way switches will be wired the same way; black wire on dark terminal, white wire attached to terminal horizontally opposite black wire, red wire on the terminal below white wire terminal and bare wire attached to switchbox.

Note: There will be no splices in the switchboxes.

J. The bare wire from source will be spliced with bare wire from both switches plus one jumper wire to be attached to the junction box.

K. The black wire from the switch on the right will be attached to the other terminal on the porcelain receptacle.

ELECTRICITY

JOB SHEET #3 - WIRING A FOUR-WAY SWITCH

I. Tools needed:

A. Linesman pliers

B. Needle nose pliers

C. Romex cable rippers

D. Wire strippers

E. 3 switchboxes

F. One junction box

G. Screwdriver

II. Materials needed:

A. Two pieces of 14-2 WG NM Romex 18 inches long

B. Two pieces of 14-3 WG NM Romex 18 inches long

C. Two three-way switches

D. One four-way switch

E. One porcelain lamp receptacle

F. One 120 volt plug (three prone)

G. One piece of plyboard 3/4" X 10" X 18"

H. Eight 3/4" No. 12 wood screws

III. Procedure:

A. Fasten all three switchboxes to the bottom of the plyboard evenly spaced 6" apart with wood screws.

B. Rip all four romex cables 6" from each end.

C. Strip the insulation on all wires on all cables 1" from end.

D. Using the 14-2 WG NM Romex cable as the source wire, attach the black wire to the dark terminal of the plug, the white wire to the light terminal of the plug and the bare wire to the green terminal of the plug.

E. The white wire from source will go directly to one of the terminals on the porcelain receptacle.

F. The black wire from source will go to the three-way switch on the left and attach to the dark terminal.

G. The white wire coming from the junction box will splice with the black wire coming from the middle switchbox.

H. The bare wire from source will splice with the bare wire from the left switchbox along with a jumper that will attach to the junction box.

I. The remaining white wire in the left switchbox will be attached vertically opposite the black wire on the switch. The red wire will attach to the remaining terminal which should horizontally opposite the white wire.

J. The two bare wire left in the left switchbox should be spliced together along with a jumper wire which will be attached to the box.

K. The red and white wires from the left three-way switch should be attached to the four-way switch on the bottom terminals opposite each other.

L. The remaining red and white wires from the right three-way switch should be attached to the four-way switch on the top terminals opposite each other. The red wires as well as the two white wires, should be vertically opposite each other.

M. The two bare wires in the middle switchbox should be spliced together along with a jumper wire which will be attached to the box.

N. The two remaining black wires in the middle switchbox should be spliced together.

O. The black wire in the right switchbox should be attached to the dark terminal of the three-way switch. The white wire should be attached horizontally opposite the black. The red wire should be attached to the remaining terminal which should be vertically opposite the white.

P. The bare wire in the right switchbox should be attached to the box.

Q. The white wire remaining in the junction box should be attached to the remaining terminal on the porcelain receptacle. This wire should be wrapped with black tape.

ELECTRICITY

JOB SHEET #4 - WIRING A SERIES OF THREE DUPLEX RECEPTACLES

I. Tools needed:

   A. Linesman pliers

   B. Needle nose pliers

   C. Romex cable ripper

   D. Wire strippers

   E. Three wall boxes

   F. Screwdriver

II. Materials needed:

   A. Three pieces of 14-2 WG NM Romex 18 inches long

   B. Three duplex receptacles

   C. One 120 volt male plug

   D. One piece of plyboard 3/4" X 6" X 18"

   E. Six 3/4" No. 12 wood screws

III. Procedure:

   A. Fasten all three wall boxes to the plyboard six inches apart.

   B. Rip all four romex cables six inches from each end.

   C. Strip the insulation on all wires on all cables one inch from end.

   D. Using one of the 14-2 WG NM Romex cables as the source wire, attach the black wire to the dark terminal of the plug, the white wire to the light terminal of the plug and the bare wire to the green terminal of the plug.

   E. Attach romex cables to the wall boxes.

   F. Attach the source cable to the first box in the series.

   G. Attach the black wire to the dark terminal on the bottom and the white wire on the light terminal on the bottom.

ELECTRICITY

JOB SHEET #5 - WIRING A 240-VOLT SPECIAL PURPOSE OUTLET

I. Tools needed:

   A. Linesman pliers

   B. Needle nose pliers

   C. Romex cable ripper

   D. Wire strippers

   E. Screwdriver

II. Materials needed:

   A. One piece of 12-3 WG romex NM cable 18 inches long

   B. One 240 volt male plug

   C. One piece of plyboard 3/4" X 6" X 6"

   D. Two 3/4" No. 12 wood screws

III. Procedure:

   A. Fasten the special purpose outlet to the plyboard with the wood screws.

   B. Rip the romex cable six inches from each end.

   C. Strip the insulation on all three wires of the cable one inch from the end.

   D. Attach the white wire to the light colored terminal of the special purpose outlet located in the middle usually.

   E. Attach black and red wires to the remaining terminals. The color of the terminals does not matter since both are hot wires.

   F. Wire the plug in the same manner as you did the receptacle.
   Note: A 240 volt circuit requires two breaks of 120 volts each.

   Warning: It is always wise to consult the national electrical code before wiring a special purpose outlet.

ELECTRICITY

TEST

I. Match the terms below to the correct definition.

___A. An electrical line which carries 240 volts.

___B. An outlet wired for a stationary piece of equipment like a range, dryer, refrigerator, air conditioner, etc.

___C. An outlet wired for a piece of equipment , usually stationary, that requires 240 volts.

___D. A device that opens or closes one wire of a circuit.

___E. A device, when used in conjunction with two three-way switches, will open or close one wire of a circuit from a third location.

___F. A device that will open or close one wire of a circuit at two different locations.

___G. A metal or plastic box installed in the ceiling to serve as a junction or mounting place for lighting fixtures.

___H. A metal or plastic box installed in the wall to serve as a junction box or a mounting place for an electrical device.

___I. This is a wire that has both "hot" and "neutral" wires and carries the source for the circuit.

___J. Usually a fused switch that opens or closes the main feeders to a building.

___K. A device for over current protection that will open a circuit automatically and can be manually or automatically reset and used again.

1. 240-Volt Special Purpose Outlet
2. Jumper Wire
3. Three-Way Switch
4. Junction Box
5. Source Wire
6. Switchbox
7. Two-Way Switch
8. 240-Volt Service
9. Hot Line
10. Circuit Breaker
11. Main Disconnect Switch
12. Special Purpose Outlet
13. System Ground
14. Four-Way Switch

___L. An energized wire.

___M. A line used in the building as the main ground wire.

___N. A short piece of wire used when a circuit has to continue without being broken. This wire is used frequently when wiring a series of lights or the bare wire (equipment ground) is used.

II. Define a 240 volt service.

ELECTRICITY

ANSWERS TO TEST

I. A. 8
   B. 12
   C. 1
   D. 7
   E. 14
   F. 3
   G. 4
   H. 6
   I. 5
   J. 11
   K. 10
   L. 9
   M. 13
   N. 2

II. A 240 volt service has three lines running to the residence. Two of the lines are "hot" lines which have 120 volts each. The other line us a neutral line which is used for the system ground.

SECTION H

UNIT I

CONCRETE AND MASONRY FOR STRUCTURES

CONCRETE AND MASONRY FOR STRUCUTRES

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to pour footings and build a solid foundation for a structure. This knowledge will be evidenced through demonstration and by scoring at least eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with concrete and masonry to the correct definitions.

II. Discuss in paragraph form, the common widths and thicknesses of footings when laying a masonry wall.

III. Demonstrate the ability to:

  a. Set up and level a builders level.

  b. Set up batter boards.

  c. Put in reinforcement rods for footings.

  d. Mix mortar.

  e. Build corners for foundations.

  f. Lay wall using a level line.

CONCRETE AND MASONRY FOR STRUCTURES

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide each student with information and job sheet.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and job sheets.

   F. Take students to a job site while footings and walls are being laid.

   G. Demonstrate and discuss procedures outlined in the job sheets.

   H. Give test.

II. Students:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheets.

   D. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency master

      1. TM 1 - Batter Boards

      2. TM 2 - Leveling Line On Batter Boards

   3. TM 3 - Reinforcement Rods
   4. TM 4 - Building Corners

D. Job sheets

   1. Job sheet #1 - Setting Up and Leveling A Builders Level
   2. Job sheet #2 - Set Up Batter Boards
   3. Job sheet #3 - Putting In Reinforcement Rods for Footing
   4. Job sheet #4 - Mixing Mortar
   5. Job sheet #5 - Building A Corner For Foundation Wall
   6. Job sheet #6 - Lay Wall Using A Level Line

E. Test

F. Answers to test

II. References:

A. Building Concrete Farm Structures, Portland Cement Association.

B. Cement Mason's Curriculum, Stillwater, Oklahoma, Oklahoma State Department of Vocational and Technical Education, 1975.

C. Agricultural Mechanics, Concrete I, II, III, Little Rock, Arkansas, Arkansas Department of Vocational Education.

CONCRETE AND MASONRY FOR STRUCTURES

INFORMATION SHEET

I. Terms and definitions.

A. BUILDERS LEVEL - Instrument consisting of a telescope, leveling bubble and tripod; used primarily for establishing grade levels.

B. LEVEL LINE - A level line used to find building line when using batter boards.

C. BATTER BOARDS - A temporary framework used to assist in locating corners when laying out a foundation.

D. PLUMB BOB - An instrument used to plumb a line or find the exact point of reference.

E. REINFORCEMENT ROD - Rods used to keep concrete from cracking.

F. FOOTING - A foundation put down below the ground surface to support a block or brick wall.

G. MORTAR SAND - Sand used when making mortar.

H. MIXING HOE - A hoe usually with two holes in the blade used for mixing mortar.

I. MIXING TUB - Tub used for mixing concrete or mortar.

J. BRICK TRIAL - A triangular shape tool used when laying bricks or blocks.

K. CHALK LINE - A tool which is used to snap a chalk line on material.

L. MASONRY LEVEL - A level used to level bricks and blocks.

M. MORTAR - A building material made of sand, cement and water. It is used to bond bricks and blocks together.

N. MORTAR BED - A bed of mortar used when laying a course of bricks.

O. PLUMB - Vertically level.

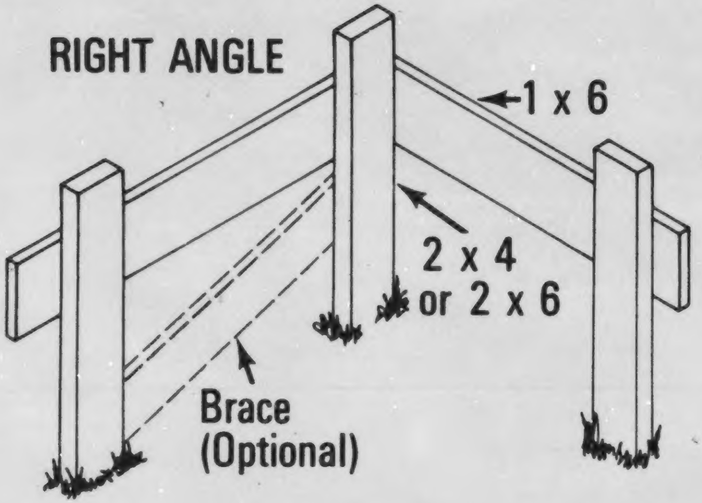
P. CORNER FASTENERS - Instrument used when fastening to corner brick. It is used to hold nylon twine when laying brick to the line.

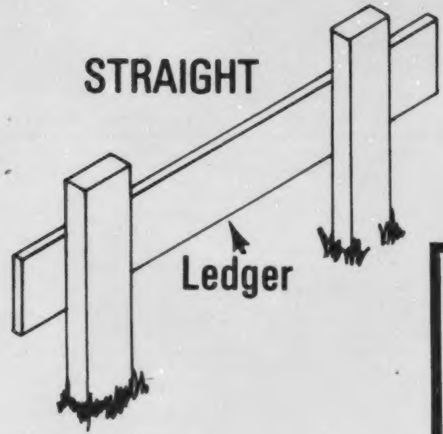
INFORMATION SHEET

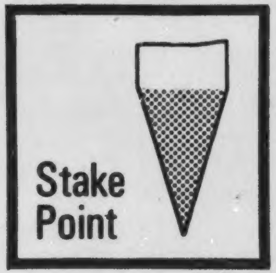
II. Footing widths and thicknesses.

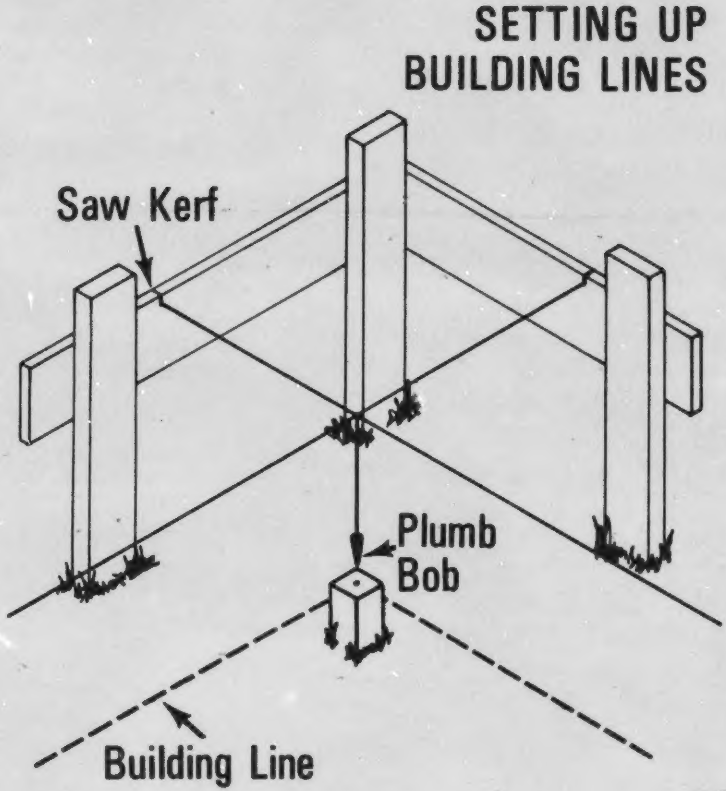
A. It is common practice to make footings for concrete masonry walls about twice as wide as the wall is thick. Footings are commonly made about half as thick as they are wide. An 8 inch wall would have a 16 inch wide footing 8 inches thick.

Batter Boards

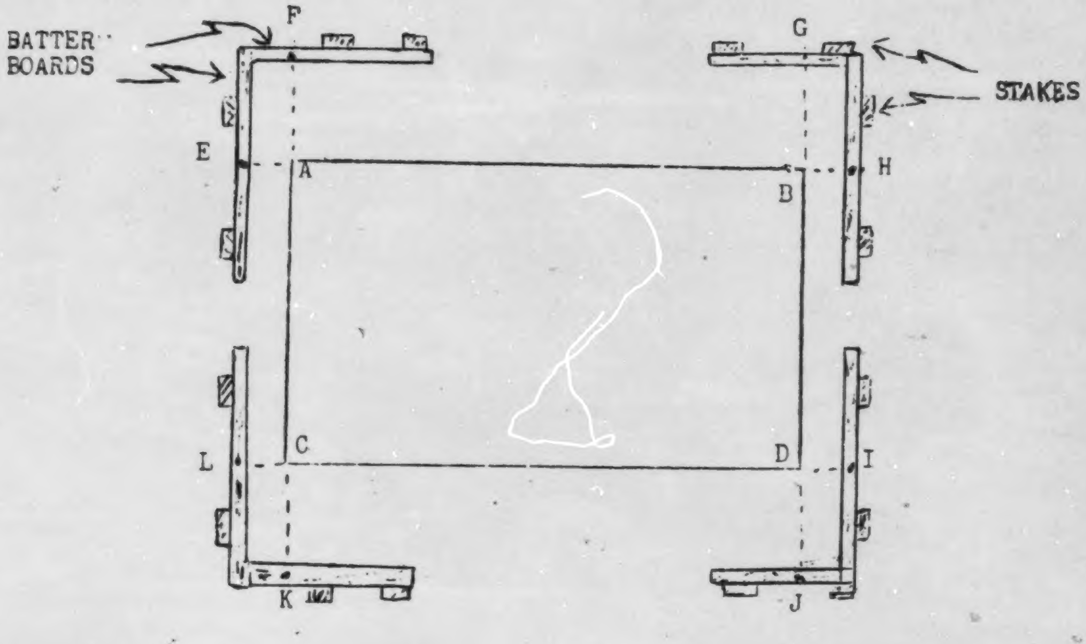

RIGHT ANGLE
1 x 6
2 x 4
or 2 x 6
Brace
(Optional)


STRAIGHT
Ledger

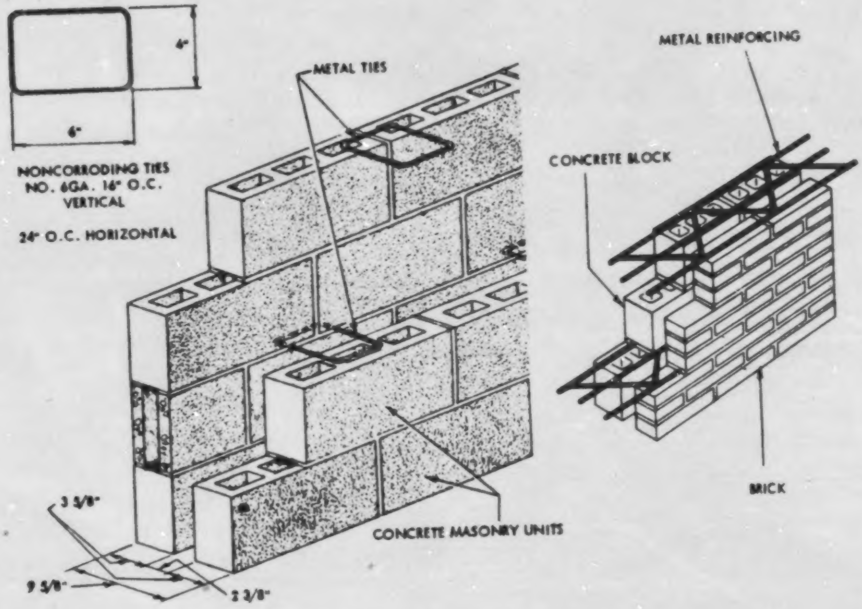

Stake
Point


SETTING UP
BUILDING LINES
Saw Kerf
Plumb
Bob
Building Line

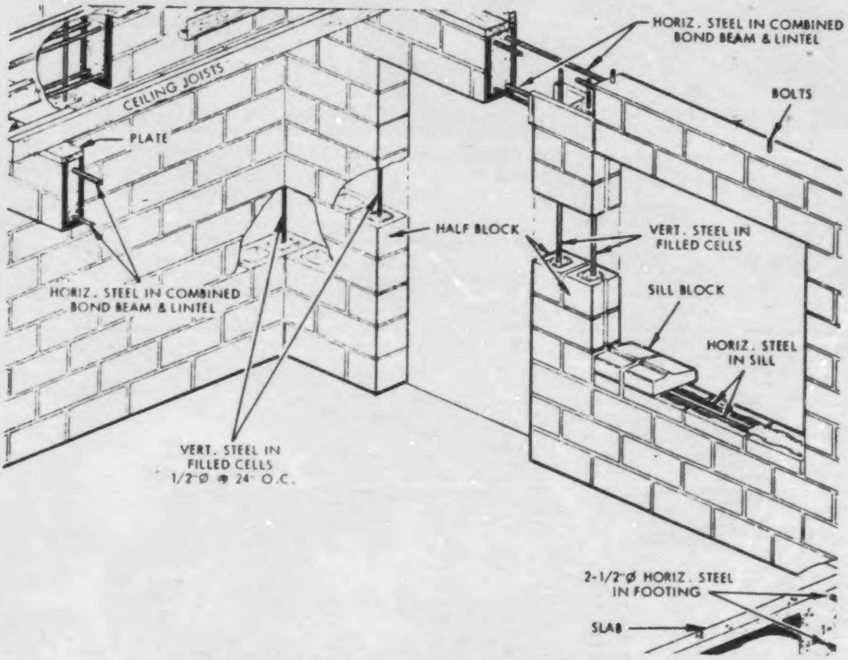
LEVELING LINE ON
BATTER BOARDS


BATTER
BOARDS
F
G
STAKES
E
A
B
H
L
C
D
I
K
J
2

Reinforcement Rods

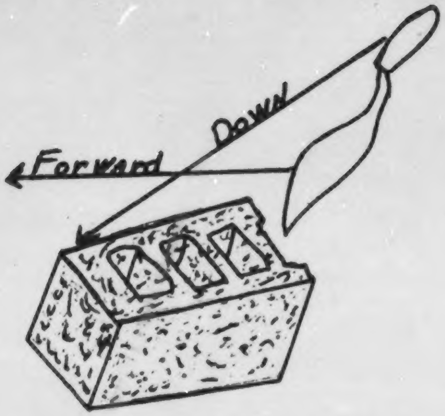

6"
6"
NONCORRODING TIES
NO. 6GA. 16" O.C.
VERTICAL
24" O.C. HORIZONTAL
METAL TIES
METAL REINFORCING
CONCRETE BLOCK
BRICK
CONCRETE MASONRY UNITS
3 5/8"
9 5/8"
2 3/8"

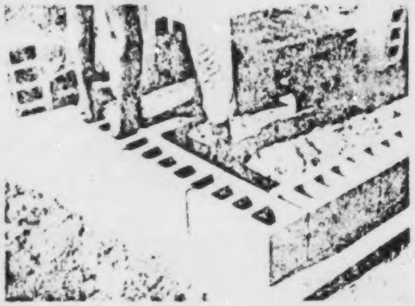
Typical masonry cavity walls.


CEILING JOISTS
PLATE
HORIZ. STEEL IN COMBINED BOND BEAM & LINTEL
BOLTS
HALF BLOCK
VERT. STEEL IN FILLED CELLS
SILL BLOCK
HORIZ. STEEL IN SILL
HORIZ. STEEL IN COMBINED BOND BEAM & LINTEL
VERT. STEEL IN FILLED CELLS 1/2"Ø @ 24" O.C.
2-1/2"Ø HORIZ. STEEL IN FOOTING
SLAB
1"

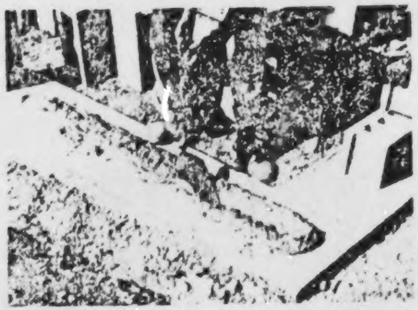
Steel reinforcing may be used in several ways.

Building Corners

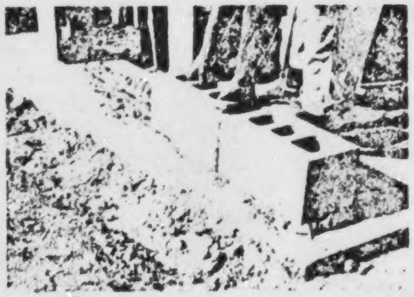




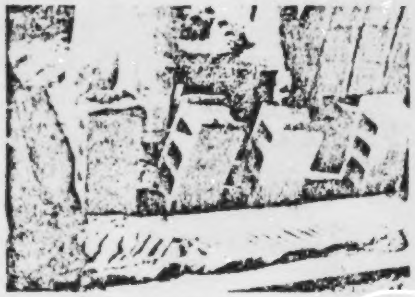
1 Checking the layout.



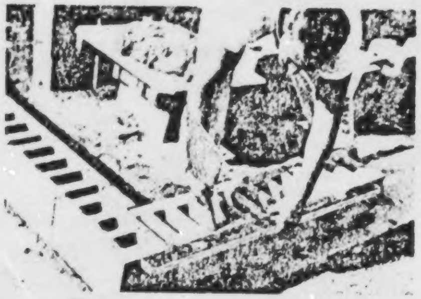
2 A full mortar bed.



3 One block—guide to entire corner.



4 Buttering face shell for vertical joint.



5 Aligning block in the first course.

6 Bringing block to grade.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #1 - SETTING UP AND LEVELING A BUILDING LEVEL

I. Tools and equipment needed:

  A. Builders level

  B. Tripod

II. Procedure:

  A. Set the three legs of the tripod 3 feet apart.

  B. Check headplate to see if it is level. If not, make necessary corrections with the tripod legs.

  C. Remove the builders level from the carrying case by lifting the level bar.

  D. Attach the level to the headplate of the tripod by screwing it down.

  E. Remove the dust cap from the lens and attach the sun shade.

  F. Align telescope barrel directly over one pair (opposite each other) of the leveling screws.

  G. Turn leveling screws so as to bring bubble to the center of the leveling tube.

  H. After leveling the level in that position, swing it 90 degrees directly across the other pair of leveling screws and level the instrument again.

  I. Repeat steps G and H until the leveling bubble stays in same position throughout a 360° turn.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #2 - SET UP BATTER BOARDS

I. Tools and equipment needed:

A. 16 stakes 18" long

B. Sledge hammer

C. 16 penny nails

D. 8 pieces 1 X 4, 3 feet long

E. Builders level and tripod

NOTE: When the lines of the building have been located and the corners are established, batter boards should be constructed to make a place for attaching thread to represent the lines of the building.

II. Procedure:

A. When corners of the future building are located, construct batter boards as follows.

B. Drive stakes around each corner of the building about two feet beyond the corner and 90° to each other.

C. Put batter boards on the stakes of the highest corner 6" above the ground.

D. Set up and level builders level and level all the other batter boards to the same height as the first set of batter boards.

E. After leveling all batter boards, stretch nylon twine over corner with the use of a plumb bob.

F. Mark and notch where twine hits the batter boards with plumb bob directly over corner.

G. Pull twine tight so it is about 6" above the ground.

H. Follow steps E,F,G on all 4 corners.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #3 - PUTTING IN REINFORCEMENT RODS FOR FOOTING

I. Tools and equipment needed:

A. Sledge hammer

B. Reinforcement rods

C. Bailing wire

NOTE: It is common practice to make footings for concrete masonry walls about twice as wide as the wall is thick. Footings are commonly made about half as thick as they are wide.

II. Procedure:

A. Assuming the wall will be eight inches wide, dig footing 16" wide and 8" deep.

B. Drive two 24" reinforcement rods every 8', about 5" apart.

NOTE: Make sure the rod will end up below the surface of the footing.

C. Using the bailing wire, tie up a reinforcement rod to the stake.

D. It is necessary to make two runs of reinforcement rods.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #4 - MIXING MORTAR

I. Tools and equipment needed:

  A. 1 sack of masonry cement

  B. 250 lbs. mortar sand

  C. Enough water to make workable

  D. Mixing hoe

  E. Mixing tub

II. Procedure:

  A. Put cement and sand in mixing tub.

  B. Mix these ingredients thoroughly before adding water.

  C. Add enough water to make a mud and thoroughly mix until workable.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #5 - BUILDING A CORNER FOR FOUNDATION WALL

I. Tools and equipment needed:

- A. Brick trial
- B. Chalk line
- C. Masonry level
- D. 19 concrete blocks 8 X 8 X 16
- E. Masonry mortar

II NOTE: Before laying any blocks, it is necessary to locate exactly where corner will be. This is done as follows:

1. Space one row of blocks on the footing allowing enough gap in between each block for mortar.
2. The beginning and the ending of the row will be corner blocks.
3. You have now determined where two of the corners will be located. Follow the same procedure when finding the other corners of the building.

II. Procedure for building a corner:

- A. String out 4 blocks exactly on the building line and snap a chalk line where the blocks have been laid out.
- B. Establish a mortar bed by putting 5/8" mortar along the chalk line.
- C. Lay block with the thicker end of the face shell up. Place the corner block very accurately in place by leveling and plumbing it.
- D. Stand three blocks on their end and butter all of them.
- E. Lay each block down in the bed and push the ends together.
- F. After 4 blocks have been laid, level and plumb each block.

NOTE: When leveling and plumbing blocks, make sure that 3/8" of mortar remains between every block.

G. After the first course has been laid, leveled and plumbed, butter the surface of the first course and the end of blocks to be used for laying the second course.

H. Corners are built four or five blocks higher than the center of the wall.

CONCRETE AND MASONRY FOR STRUCTURES

JOB SHEET #6 - LAY WALL USING A LEVEL LINE

I. Tools and equipment needed:

A. Brick trowel

B. Enough blocks to catch lay 4 courses of brick.

C. Mortar

D. Nylon twine

E. Corner fasteners

F. Masonry level

G. Chalk line

II. Procedure:

A. After joints have hardened, put corner fasteners on both corners where the top of the first course should be.

B. Stretch level line by attaching nylon twine to both corner fasteners to form a level line.

C. With the chalk line, snap a line on both outside and inside from corner to corner. This will be the guide for the mortar pad.

D. Apply a mortar pad from corner to corner.

E. Butter both ends of one brick and one end of four bricks.

F. Using the level line as a guide, place the brick buttered on both ends to the brick on the bottom course of the corner.

G. Tap down block with the trowel to the level line. Take masonry level and plumb the brick.

H. Continue this process until the wall is even with the top corner block.

CONCRETE AND MASONRY FOR STRUCTURES

TEST

I. Match the terms below to the correct definition.

___A. Instrument consisting of a telescope,leveling bubble and tripod; used primarily for establishing grade levels.

___B. A level line used to find building line when using batter boards.

___C. A temporary framework used to assist in locating corners when laying out a foundation.

___D. An instrument used to plumb a line or find the exact point of reference.

___E. Rods used to keep concrete from cracking.

___F. A foundation put down below the ground surface to support a block or brick wall.

___G. Sand used when making mortar.

___H. A hoe usually with two holes in the blade used for mixing mortar.

___I. Tub used for mixing concrete or mortar.

___J. A triangular shape tool used when laying brick or blocks.

___K. A tool which is used to snap a chalk line.

___L. A level used to level bricks and blocks.

___M. A building material made of sand, cement and water. It is used to bond bricks and blocks together.

1. Corner Fasteners
2. Footing
3. Level Line
4. Brick Trial
5. Mixing Tub
6. Chalk Line
7. Mortar
8. Mortar Bed
9. Plumb
10. Reinforcement Rod
11. Batter Boards
12. Masonry Level
13. Mixing Hoe
14. Plumb Bob
15. Builders Level
16. Mortar Sand

___N. A bed of mortar used when laying a course of bricks.

___O. Vertically level.

___P. Instrument used when fastening to corner brick. Is is used to hold nylon twine when laying brick to the line.

II. Discuss in paragraph form, the common widths and thicknesses of footings when laying a masonry wall.

III. Demonstrate the ability to:

A. Set up and level a builders level.

B. Set up batter boards.

C. Put in reinforcement rods for footings.

D. Mix mortar.

E. Build corners for foundations.

F. Lay wall using a level line.

CONCRETE AND MASONRY FOR STRUCTURES

ANSWERS TO TEST

I.

A.	15
B.	3
C.	11
D.	14
E.	10
F.	2
G.	16
H.	13
I.	5
J.	4
K.	6
L.	12
M.	7
N.	8
O.	9
P.	1

II. Paragraph should include:

It is common practice to make footings for concrete masonry walls about twice as wide as the wall is thick. Footings are commonly made about half as thick as they are wide. An 8" wall would have a 16" wide footing 8" thick.

III. Performance skills evaluated to the satisfaction of the instructor.

SECTION I

UNIT I

SURVEYING FOR STRUCTURES

SURVEYING FOR STRUCTURES

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to use surveying principles in laying out a building and related structure. This knowledge will be evidenced through demonstration and by scoring at least eighty percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

I. Match terms associated with structural surveying to the correct definition.

II. Determine the length in a students pace.

III. Chain the distance between two given points.

IV. Break chain.

V. Layout a right angle by the 3,4,5 method.

VI. Identify four classes of levels.

VII. Set up and level a wye instrument.

VIII. Read the rod.

IX. Identify hand signals associated with the movement of the rod.

X. Solve a differential leveling probelm.

SURVEYING FOR STRUCTURES

SUGGESTED ACTIVITIES

I. Instructor:

A. Provide students with objective sheet.

B. Provide students with information and assignment sheets.

C. Make transparencies.

D. Discuss terminal and specific objectives.

E. Discuss information and assignment sheets.

F. Direct participants through the different learning paths for each specific objective.

F. Give test.

G. Discuss test.

II. Student:

A. Read objectives.

B. Study information sheet.

C. Complete each assignment sheet.

D. Make sure you are to perform according to the type of performance called for by each specific objective.

E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

A. Objectives

B. Information sheets

C. Transparency masters

1. TM 1 - Laying Out A Triangle by The Three, Four, Five Method

2. TM 2 - Four Classes of Levels

        3. TM 3 - Reading the Rod
        4. TM 4 - Hand Motions
        5. TM 5 - Differential Leveling of Bench Marks
        6. TM 6 - Differential Leveling
    D. Assignment sheet
        1. Assignment sheet #1 - Solving A Pacing Problem
    E. Answers to assignment sheets
    F. Job sheets
        1. Job sheet #1 - Chaining
        2. Job sheet #2 - Solving a Differential Leveling Problem
    G. Test
    H. Answers to test

II. References:

A. Schwab, Glenn O., Barnes, Kenneth K., Frevert, Richard K., Edminster, Talcott W., Elementary Soil and Water Engineering, John Wiley and Sons, Inc.

B. Brinker, Russell C., Elementary Surveying, Scranto, Pennsylvania, International Textbook Co.

C. Curriculum Guides, Stillwater, Oklahoma, Curriculum and Instructional Materials Center, State Department of Vocational and Technical Education.

SURVEYING FOR STRUCTURES

INFORMATION SHEET

I. Terms and definitions:

A. BENCH MARK - A permanent point of known elevation.

B. FRONTSIGHT - A rod reading taken on a point of unknown elevation.

C. BACKSIGHT - A rod reading taken on a point of known elevation.

D. HEIGHT OF INSTRUMENT - The elevation of the level line of sight.

E. TURNING POINT - A temporary location used to determine a new height of instrument.

F. PACING - Process of determining the natural length of step by pacing a measured distance.

G. CHAINING - Measuring the distance between two given points.

H. BREAKING CHAIN - A process of determining the true horizontal distance on slopes greater than five percent. (5%)

I. RIGHT ANGLE - The angle bounded by two lines perpendicular to each other.

J. TRIPOD - A three legged device used to support the instrument.

K. ENGINEERS CHAIN - A measuring device 100' long used in chaining.

L. SLOPE - Feet fall in 100 feet (usually given in percent%).

M. 3-4-5 METHOD - A method to layout a right angle.

II. Determining the length of a students pace.

A. Mark off 100 feet.

B. Pace (walk) the distance in a natural walk.

C. Student needs to walk the distance several times to be sure he or she is consistant in their pace.

INFORMATION SHEET

D. Divide the number of paces into 100 feet.

Example: 38 number of paces in 100 feet. 100 feet distance paced.

$$38\,\overline{)100.00}\quad 2.63$$

2.63 = Number of feet in students pace.

III. Proper procedure for chaining the distance between two given points.

A. Lead chainman has 10 surveyers pins and the "100" mark of an engineers chain.

B. Rear chainman has 1 surveyers pin which he puts at the starting point.

C. Lead chainman pulls the tape straight and with a 15 lb. pull while the rear chainman holds the 100' mark of the chain on the starting point.

D. When the 100 feet is reached, the rear chainman calls "stick". At that time, the lead chainman sticks a pin at the "100" mark on the chain and calls "stuck".

E. After the pin has been stuck, the lead chainman pulls the chain to the next 100 feet. The rear chainman follows up and picks up the pin.

F. C,D and E are repeated until lead chainman has no more pins. The distance to the 11th pin is 1000'. At that time the rear chaniman gives 10 pins to the lead chainman and repeat the steps C,D and E.

IV. Proper procedure for breaking chain.

A. On slopes greater than 5%, it may be necessary to "Break Chain".

B. Rear chainman hold chain at starting point while lead chainman moves down the hill 25 feet. (Refer to example breaking chain.)

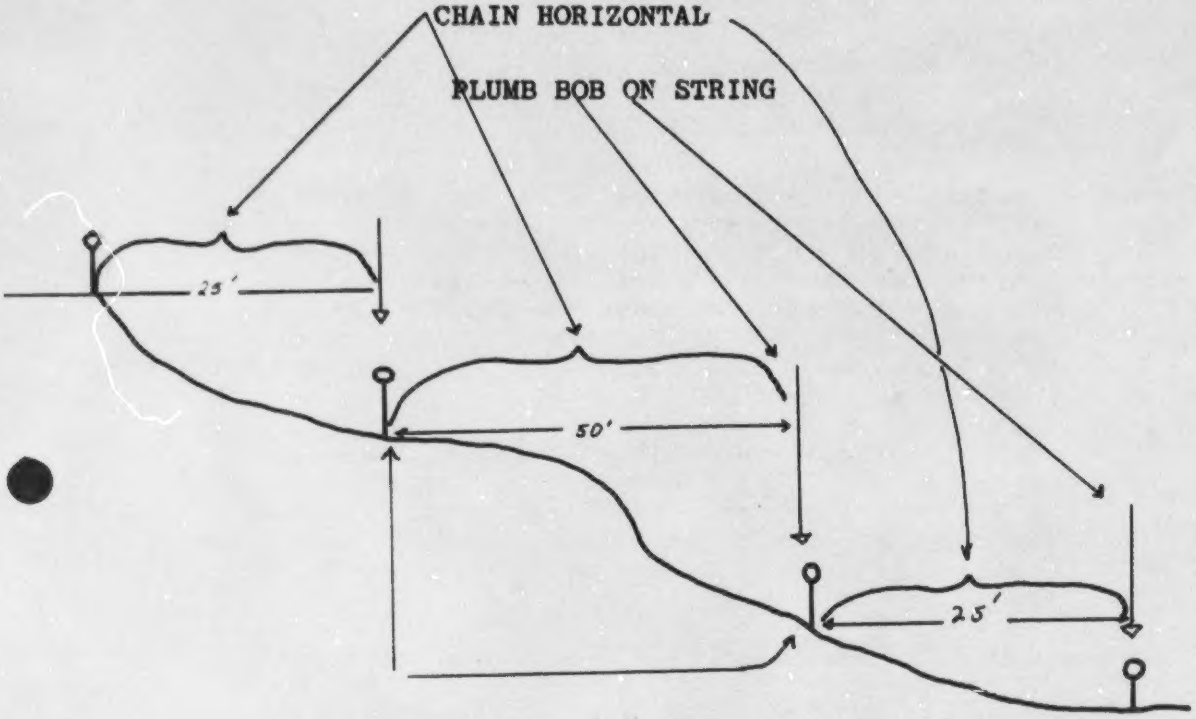
C. Lead chainman holds plumb-bob on a string on the 100' mark of the chain then marks with a pin where the plumb-bob touches the ground.

D. At that time, the rear chainman comes up to the pin and puts the chain on the pin while lead chainman moves on down the hill and repeats the procedure.

INFORMATION SHEET

E. The most important thing to remember when breaking chain is to keep the chain as horizontal as possible.

Example: Breaking Chain

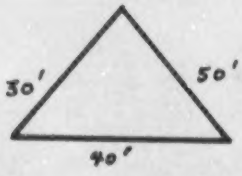

CHAIN HORIZONTAL
PLUMB BOB ON STRING
25'
50'
25'

Pins Not Counted

V. Laying out a right angle by the 3-4-5 method.

A. To layout a right angle with this method it is necessary to layout a triangle whose sides are in the proportion of 3,4 and 5.

B. Convenient lengths are the leg 30 feet, base 40 feet and the hypotanus 50 feet.



INFORMATION SHEET

VI. Identify four classes of levels.

A. Wye Level - There are four leveling screws that level the instrument upon the base plate. In the wry level, the telescope with bubble tube attached rests in two Y-shaped bearings and is held in place by easily removable clamps.

B. Dumpy Level - There are four leveling screws that level the instrument upon the base plate. The telescope and bubble tube are rigidly attached to the frame of the instrument.

C. Tilting Level - This type often has only three screws for leveling upon the base plate. The bubble tube affixed to the telescope tube is viewed through aprism system with an eye piece adjacent to the telescope eyepiece. The prisms permit both ends of the bubble to be viewed simultaneously in a split image. The instrument is leveled for each 8 reading.

D. Self-Leveling-Level - This level automatically sets its own level line of sight through aprism system that includes aprism suspended by wires from the upper portion of the telescope barrel and free to swing as a damped pendulum acting under the force of gravity.

VII. Procedure for setting up and leveling a wye instrument:

A. Set up tripod by loosening the nuts on the tripod head and spreading legs 3 or 4 feet (distance may vary depending on what it takes to keep tripod head level) and push them firmly into the ground.

B. Tighten the nuts holding the legs to the tripod head.

C. Pick up instrument out of box by handling the telescope in the center with the left hand. Make sure that telescope clamp screw is loose, the nut on tripod head and screw base of instrument on the tripod head with the right hand. After the instrument is securely attached, you may let go with your left hand.

D. Swing the telescope to a position directly over an opposite pair of leveling screws.

E. Turn these screws so that the thumbs move toward one another or away from one another. The bubble

INFORMATION SHEET

will move in the same direction as the left thumb. Keep the leveling screws tight against the base plate but not tight enough to jam against the base plate.

F. Turn the telescope to a position across the opposite pair of leveling screws and level the bubble again.

G. Repeat over each opposite pair of screws until the bubble stays level throughout a 360° circle.

VIII. Reading the rod. TM 3

If the rod is graduated in tenths of inches, the width of one black line is 1/100 (0101) feet and the width of a white space is 1/100 (0.01) feet. The reading gives the distance in feet from the lower end of the rod. Many surveyers find it helpful if the rodman waves the rod back and forth through the true vertical position. If this is done, the instrument man can read the minimum horizontal cross-hair reading which is the true reading.

IX. Hand signals associated with surveying.

Refer to TM 4.

X. Solving a differential leveling problem.

A. Differential leveling consists of making a series of instrument setups along the general route between the points and each setup taking a rod reading back to a point of previously determined elevation and reading forward to a point of unknown elevation. These points at which elevations are known are called bench marks (B.M.) or turning points (T.P.).

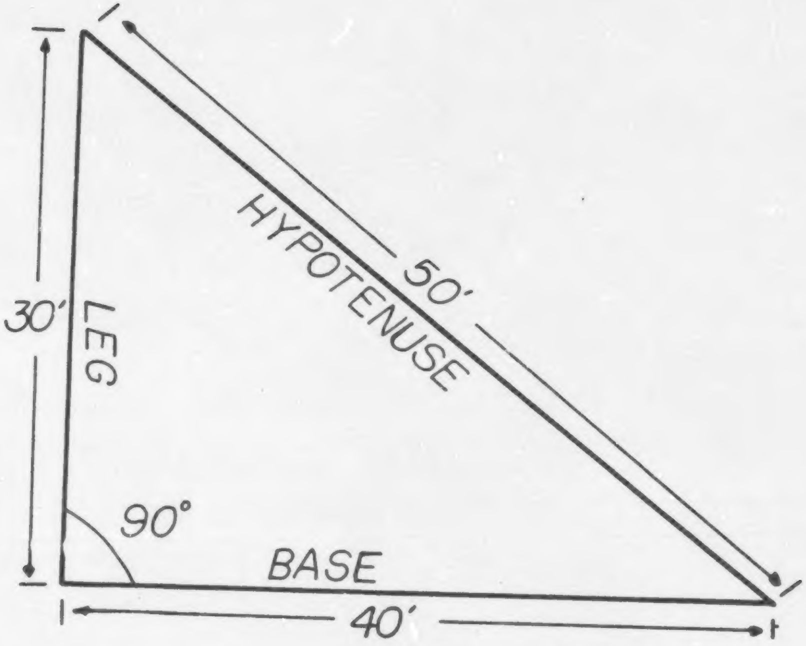
B. For example, referring to TM 5, if the elevation of bench mark number 1 (B.M.1) is known to be 100.00 feet, the elevation of B.M. 2 can be found by differential leveling. The first setup of the instrument is made at some point a convenient distance away from B.M.1 and in the general direction of B.M 2. This distance will depend on the magnicing power and accuracy of the instrument, but in most cases the distance will be from 75 to 200 feet. The rod is held on B.M 1 and the rod reading (in this case, 6.62) is taken and put in notebook. This reading is a backsight; it is a reading taken on a point of known elevation.

INFORMATION SHEET

Addition of the backsight on B.M. 1 to the elevation of B.M. 1 gives the elevation of the line of sight. (In this case 100.00 + 6.62 = 106.62) This is the height of instrument (H.I.) and is entered in the H.I. column of the notebook. Notice that in the notebook the H.I. is entered on the line between the B.M. 1 line and the T.P. 1, indicating that the instrument is set up between B.M.1 and T.P. 1. After the backsight on B.M. 1 has been recorded, the rodman moves to T.P. 1 and sets a stake or finds some other firm object on which to rest the rod. With the instrument still at setup 1, a rod reading is taken on T.P. 1. This reading is a foresight; it is a reading taken on a point of unknown elevation. The foresight (in this case 3.21) is entered in the field book opposite T.P. 1 and in the column headed F.S. The elevation of T.P. 1 from the instrument height (in this case 106.62 - 4.21 = 102.41) and this elevation is entered in the notes opposite T.P. 1 and in the column headed elevation. Note that T.P. 1 now becomes a point of known elevation. The rodman remains at T.P. 1 while the instrument man moves to setup 2. From this position a backsight is taken on T.P. 1, the new H.I. is determined and T.P. 2 is established and its elevation is determined as was previously done for T.P. 1. The same sequence of events is carried through until B.M. 2 is reached.

C. A check on the arithmetical accuracy of differential leveling notes may be made by taking the difference in the sum of all the foresights from the sum of all the backsights and comparing this difference with the difference between the final and initial elevations. If the two differences are equal, the notes are arithmetically correct. However, this does not check errors in rod reading or in instrument adjustment.

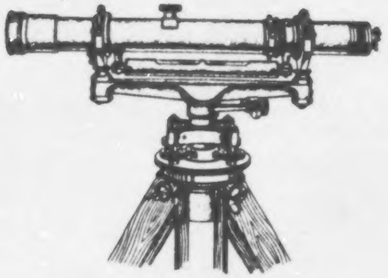
LAYING OUT A TRIANGLE BY THE THREE, FOUR, FIVE, METHOD


50'
HYPOTENUSE
30'
LEG
90°
BASE
40'

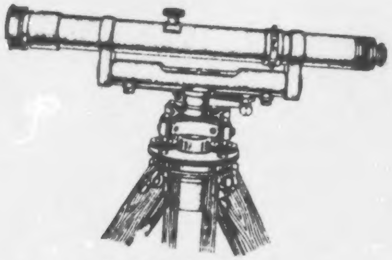
AS - 13-I

TM 2

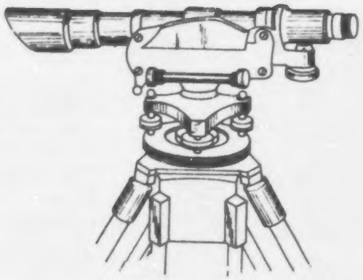
Four Classes of Levels



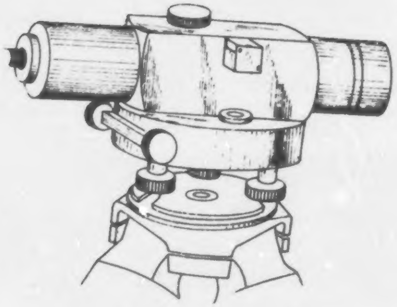
A. WYE LEVEL



B. DUMPY LEVEL



C. TILTING LEVEL

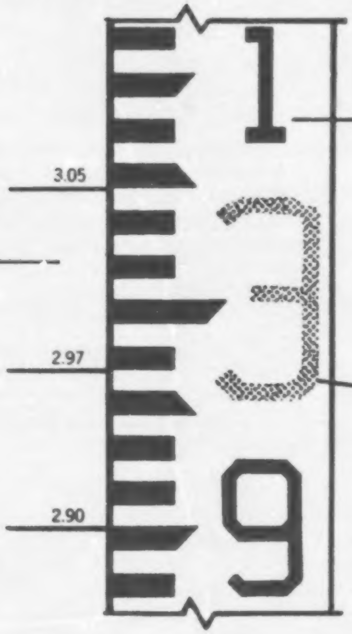


D. SELF-LEVELING LEVEL

AS - 15-I

TM 3

Reading the Rod



Tenths of Feet

(Black)

Hundredths of Feet

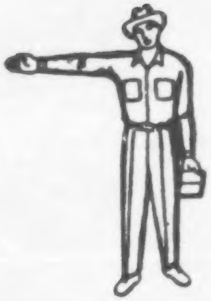
(Black and White)

Full Foot Numbers

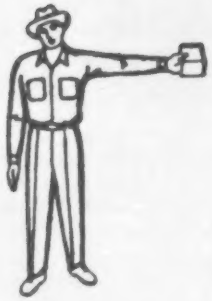
(Red)

NOTE: Vernier scale reads thousandths of feet

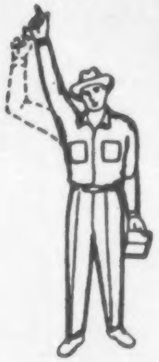
Hand Motions



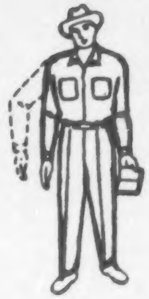
Move in this Direction



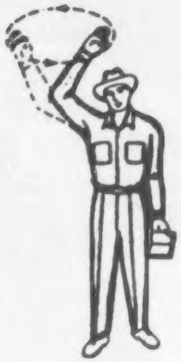
Move in this Direction



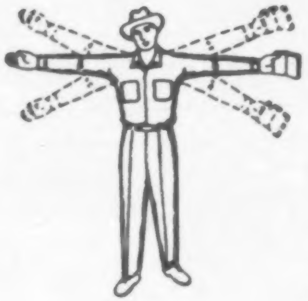
Move Up



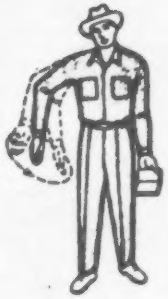
Move Down



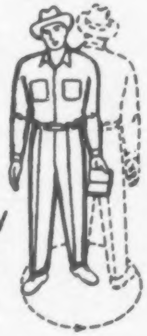
Turning Point



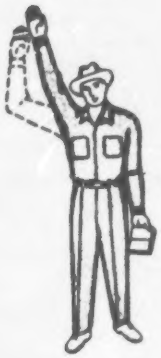
Observation Completed
or Move On
or Understood



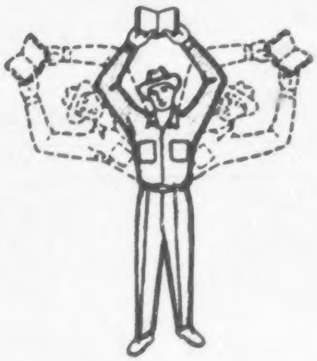
Come In


Step
Away
from
Inst.
Walk
in
Tight
Circle

Wrong Face
or Check Clamp
or Rod Upside Down

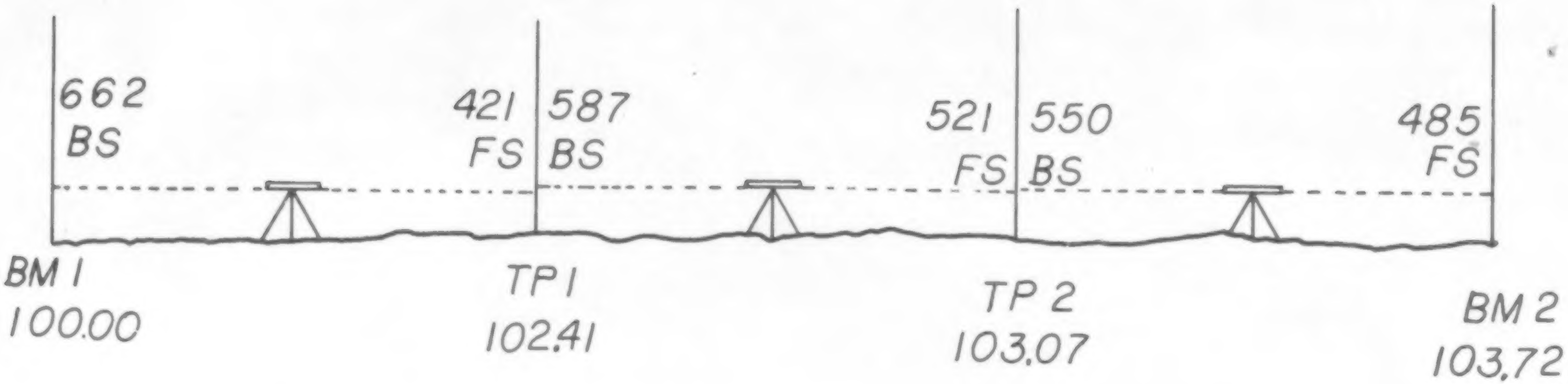


Use
Long Rod



Wave Rod from
Side to Side

DIFFERENTIAL LEVELING OF BENCH MARKS


662
BS
421
FS
587
BS
521
FS
550
BS
485
FS
BM 1
100.00
TP 1
102.41
TP 2
103.07
BM 2
103.72

S. QUILLMAN	DIF. LEVELING	3 INCH = 50 FEET	1/4/77

DIFFERENTIAL LEVELING

STA.	B.S.	HI.	F.S.	ELEV.
BM 1	6.62			100.00
		106.62		
TP 1	5.87		4.21	102.41
		108.28		
TP 2	5.50		5.21	103.07
		108.57		
BM 2	4.64		4.85	103.72
		108.36		
TP 3	4.30		5.19	103.17
		107.47		
TP 4	4.72		6.18	101.29
		106.01		
BM 1			6.01	100.00

SURVEYING FOR STRUCTURES

ASSIGNMENT SHEET #1 - SOLVING A PACING PROBLEM

Proper procedure for determining the length in a students pace.

A. Mark off 100 feet.

B. Pace (walk) the distance in a natural walk.

C. Student needs to walk the distance several times to be sure he or she is consistant in their pace.

D. Divide the number of paces into 100 feet.

Example: 38 number of paces in 100 feet. 100 feet distance paced.

$$38 \overline{)100.00} \quad \text{(quotient } 2.63\text{)}$$

2.63 = Number of feet in students pace.

Solve the following pacing problem using the procedure above.

A. If a student paced a 100' distance several times and found that it took 30 paces, how many feet would be in the students pace.

______________________________feet.

B. A student paced 100' several times and found it took 43, 44,45,and 46 paces to walk 100'. 1.) How would you figure the number of feet in deciding the students pace?. 2.) How many feet in the students pace?

1. ____
2. ____

SURVEYING FOR STRUCTURES

ANSWERS TO ASSIGNMENT SHEETS

Assignment sheet #1

A. 3.33 feet

B. 1. By taking an average

   2. 2.25 feet

SURVEYING FOR STRUCTURES

JOB SHEET #1 - CHAINING

I. Tools and materials needed:

  A. Engineers chain

  B. 11 surveyors pins

II. Procedure:

  A. Lead chainman has 10 surveyors pins and the "100" mark of an engineers chain.

  B. Rear chainman has 1 surveyors pin which he puts at the starting point.

  C. Lead chainman pulls the tape straight and with a 15 lb. pull while the rear chainman holds the 100' mark of the chain on the starting point.

  D. When the 100' is reached, the rear chainman calls "stick". At that time the lead chainman sticks a pin at the "100" mark on the chain and calls "stuck".

  E. After the pin has been stuck, the lead chainman pulls the chain to the next 100 feet. The rear chainman follows up and picks up the pin.

  F. C,D and E are repeated until lead chainman has no more pins. The distance to the 11th pin is 1000'. At that time the rear chainman gives 10 pins to the lead chainman and repeat the steps C,D and E.

III. Chain the north, south distance of the agriculture building.

  A. ______________________________feet.

SURVEYING FOR STRUCTURES

JOB SHEET #2 - SOLVING A DIFFERENTIAL LEVELING PROBLEM

I. Tools and materials needed:

A. Tripod

B. Instrument (wry)

C. Plumb bob and string

D. Philadelphia rod

E. Notebook

II. Procedure:

A. Differential leveling consists of making a series of instrument setups along the general route between the points and each setup taking a rod reading back to a point of previously determined elevation and reading forward to a point of unknown elevation. These points at which elevations are known are called bench marks (B.M.) or turning points. (T.P.)

B. For example, referring to TM 5, if the elevation of bench mark #1 (B.M. 1) is known to be 100.00 feet, the elevation of B,M. 2 can be found by differentaal leveling. The first setup of the instrument is made at some point a convenient distance away from B.M.1 and in the general direction of B.M. 2. This distance will depend on the magnicing power and accuracy of the instrument, but in most cases the distance will be from 75 to 200 feet. The rod is held on B.M. 1 and the rod reading (in this case, 6.62) is taken and put in the notebook. This reading is a backsight; it is a reading taken on a point of known elevation. Addition of the backsight on B.M.1 to the elevation of B.M.1 gives the elevation of the line of sight. (In this case, 100.00 + 6.62 = 106.62) This is the height of instrument (H.I.) and is entered in the H.I. column of the notebook. Notice that in the notebook the H.I. is entered on the line between the B.M. 1 and the T.P. 1, indicating that the instrument is set up between B.M.1 and T.P. 1. After the backsight on T.P. 1 has been recorded, the rodman moves to T.P. 1 and sets a stake or finds some other firm object on which to rest the rod. With the instrument still at setup 1, a rod reading if taken on T.P. 1. This reading is a foresight; it is a reading taken on a point of unknown elevation.

The foresight (in this case, 3.21) is entered in the field book opposite T.P. 1 and in the column headed F.S. The elevation of T.P. 1 can now be computed by subtracting the foresight of T.P. 1 from the instrument height (in this case, 106.62 - 4.21 = 102.41) and this elevation is entered in the notes opposite T.P. 1 and in the column headed elevation. Note that T.P. 1 now becomes a point of known elevation. The rodman remains at T.P. 1 while the instrument man moves to setup 2. From this point, a backsight is taken on T.P. 1, the new H.I. is determined and T.P. 2 is established, and its elevation is determined as was previously done for T.P. 1. The same sequence of events is carried through until B.M. 2 is reached.

C. A check on the arithmetical accuracy of differential leveling notes may be made by taking the difference in the sum of all the back sights and comparing this difference with the difference between the final and initial elevations. If the two differences are equal, the notes are arithmetically correct. However, this does not check errors in rod reading or in instrument adjustment.

III. Find the difference in elevation of the northeast corner of the gymnasium (B.M.1) and the northeast corner of the agriculture building following the above procedure.

STA.	B.S.	H.I.	F.S.	ELEVATION

SURVEYING FOR STRUCTURES

TEST

I. Match the terms below to the correct definition.

___A. Measuring the distance between two given points.

___B. A measuring device 100' long used in chaining.

___C. A temporary location used to determine a new height of instrument.

___D. A rod reading taken on a point of known elevation.

___E. Feet fall in 100' (usually given in percent).

___F. A three legged device used to support the instrument.

___G. A permanent point of known elevation.

___H. The elevation of the level of sight.

___I. A method to layout a right angle.

___J. Process of determining the natural length of step by pacing a measured distance.

___K. A rod reading taken on a point of unknown elevation.

___L. The angle bounded by two lines perpendicular to each other.

___M. A process of determining the true horizontal distance on slopes greater that five percent.

1. Bench Mark
2. Frontsight
3. Backsight
4. Height of Instrument
5. Turning Point
6. Pacing
7. Chaining
8. Breaking Chain
9. Right Angle
10. Tripod
11. Engineers Chain
12. Slope
13. 3-4-5 Method

II. Student will determine their pace by walking a 100' distance and turn in to instructor for grade.

III. Measure the east, west distance of agriculture building.

IV. Find the distance between two given points on an incline by breaking chain.

V. Layout a right angle by the 3-4-5 method.

VI. Identify four classes of levels.

A.

B.

C.

D.

VII. Demonstrate the procedure of setting up and leveling a wye instrument.

VIII. Demonstrate by describing the proper way to read a rod.

IX. Identify the different hand signals associated with the movement of the rod.

X. With the following information, solve this differential leveling problem by determining the elevation of B.M.2.

BM 1	B.S. 1.31	Elevation 50 feet
TP 1	B.S. 6.30	F.S. 4.75
TP 2	B.S. 4.92	F.S. 3.21
TP 3	B.S. 3.13	F.S. 5.32
BM 2		F.S. 3.22

STA.	B.S.	H.I.	F.S.	ELEVATION

SURVEYING FOR STRUCTURES

ANSWERS TO TEST

I. A. 7

B. 11

C. 5

D. 33

E. 12

F. 10

G. 1

H. 4

I. 13

J. 6

K. 2

L. 9

M. 8

II. Will depend on students natural pace.

III. Will depend on size of agriculture building.

IV. Will depend on incline assigned to student.

V. Will depend on incline assigned to student.

VI. A. Wye level

B. Dumpy level

C. Tilting level

D. Self-leveling level

VII. To the satisfaction of the instructor.

VIII. A. If the rod is graduated in tenths of inches, the width of one black line is 1/100 (0101) feet and the width of a white space is 1/100 (0.01) feet. The reading gives the distance in feet from the lower end of the rod. Many surveyors find it helpful if the rodman waves the rod back and forth through the true vertical position. If this is done, the instrument man can read the minimum horizontal cross-hair reading which is the true reading.

IX. Refer to TM 4.

X.

STA.	B.S.	H.I.	F.S.	ELEVATION
BM 1	1.31			50.00
		51.31		
TP 1	6.30		4.75	46.56
		52.86		
TP 2	4.92		3.21	49.65
		54.57		
TP 3	3.13		5.32	49.25
		52.38		
BM 2			3.22	49.16